A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JULY, 1937.

GENERAL PHYSICS.

ADSORPTION.

2867. Adsorption of Gases and Equation of Liquid State. E. C. C. Baly. *Roy. Soc., Proc.* 160*A. pp.* 465–487, *June* 15, 1937.—In this theoretical discussion the following conclusions are drawn: (1) The adsorption of a gas on a surface is due to the formation of adsorption complexes $S^{-}A^{+}$ in which an adsorbing unit S in the surface has donated one or more rotation or rotation-vibration quanta to a molecule of the adsorbate. (2) The adsorption complex is dissociated by the supply of an amount of energy which is equal to that donated by the adsorbing unit. (3) The fraction r of the total surface area coated by the first unimolecular layer is given by an expression identical in form with the Langmuir formula. (4) The activated molecules of gas in the first adsorbed layer can donate energy to form a second adsorbed layer of gas. (5) The total amount of gas adsorbed is the sum of that in each layer. (6) Over a limited range of pressure the relation between the total amount of gas adsorbed and the equilibrium pressure is expressed by the Freundlich isotherm. (7) The latter has no physical significance in adsorption. (8) The fundamental equation of the liquid state is found to be $p/p_0 = e^{0.6931478V^{b}} \times e^{-0.6931478V^{a/3}}$ where V is the relative volume of the liquid. (9) The vapour pressures and latent heats of liquid CO_2 between $-56{\cdot}6$ and -26°C. are accurately expressed when $a/3 = 2{\cdot}5676$ and $b = 2{\cdot}567\dot{6} \times 1{\cdot}165806/\sqrt[3]{V}$. (10) The heat of adsorption should in general be the same for all gases. (11) The energy of desorption is the energy needed to dissociate the adsorption complexes. (12) When as a result of chemisorption a chemical reaction takes place between the adsorbing units in the surface and the molecules of the adsorbate, abnormal heats of adsorption are observed. H. H. Ho.

2868. Properties of Adsorbed Films with Repulsive Interaction between the Adsorbed Atoms. Jwu-Shi Wang. *Roy. Soc., Proc.* 161*A. pp.* 127–140, *July* 1, 1937.—Peierls' method of using Bethe's treatment of order-disorder phenomena in connection with adsorption is applied to adsorption with positive interaction energy between neighbouring adsorbed atoms. The treatment is extended to the case where a diatomic gas molecule dissociates into two atoms on adsorption. The shape of the isotherm is studied in detail and it is found that critical conditions do not occur and that the isotherm cannot even have a point of inflection. The heat of adsorption is calculated as a function of the fraction of surface covered for various interaction energies. The thermodynamic method is applied to the case of adsorption with dissociation and yields an equation analogous to the Clausius-Clapeyron equation. AUTHOR.

2869. Kinetics of Adsorption with Interaction between the Adsorbed Particles. J. K. Roberts. *Roy. Soc., Proc.* 161*A. pp.* 141–153, *July* 1, 1937.—Taking into account the effect of interaction between nearest neighbours in an adsorbed film, expressions are obtained for the rates at which evaporation and condensation occur both for simple adsorption processes when the gas molecules are adsorbed without dissociation and for the various groups of processes which must be considered when dissociation occurs on adsorption. An expression is also obtained for the rate at which a stable immobile film is formed when diatomic molecules dissociate on adsorption. Evidence which shows that the adsorbed film of H_2 on W is immobile at room-temperature is discussed and other properties of this H_2 film are considered. The rates of formation of mobile and immobile films are considered numerically and the change in the behaviour of a mobile film, in which each site for adsorption has four nearest neighbours, in the region $\theta = 0 \cdot 5$ is discussed in detail. For $\theta > 0 \cdot 5$ the interaction between adsorbed particles has an effect similar to that of an energy of activation for the adsorption process. Earlier considerations in connection with the production of atomic H are unaffected by including the effects of interaction between adsorbed particles. AUTHOR.

2870. Gibbs' Adsorption Equation and Adsorption on Solids. D. H. Bangham. *Faraday Soc., Trans.* 33. *pp.* 805–811, *June*, 1937.—The adsorption of gases is studied from the point of view of the surface energy and surface tension lowering at the interface. It is shown that where the differential heat of adsorption at a uniform surface is constant, the surface energy lowering for a given molecular adsorption is directly proportional to the absolute temperature, so long as only one surface phase is present; according to the postulates from which Langmuir's chemisorption isotherm is derived it is also independent of the total energy of adsorption, and of the nature of the adsorbed gas. The surface tension, on the other hand, which measures the work of stretching the interface, is affected only if the adsorbed molecules exert a tangential force at the boundary. The surface energy lowering and the surface tension lowering are equal only when the molecules have no fixed points of attachment. It is shown that this physical type of adsorption may play an important part where the mechanical properties of a solid agglomerate depend on the presence of adsorbed films. AUTHOR.

2871. Range of Surface Forces. R. S. Bradley. *Zeits. f. Krist.* 96. 6. *pp.* 499–503, 1937. *In English.*—The crystallisation of ammonium iodide has been studied on films of cellulose acetate and rubber deposited on mica. Normally the salt crystallises on mica with a regular tetrahedral pattern, but films of thickness greater than approximately 10^{-5} cm. tend to destroy the pattern and the crystals revert to the irregularly arranged cubic form. It is concluded that a propagation of orientation occurs in the thin films. [See also Abstract 408 (1937).] AUTHOR.

See also Abstracts 2977, 2983, 3157, 3196.

ATOMIC AND MOLECULAR STRUCTURE.

2872. Nuclear Two-, Three- and Four-Body Problems. W. Rarita and R. D. Present. *Phys. Rev.* 51. *pp.* 788–798, *May* 15, 1937.—The wave equations for the lightest nuclei up to $^4_2$He are approximately solved, assuming the forces between like and unlike particles and between particles of equal and of opposite spin to be proportional to each other. The four parameters which are then available, *viz.*, magnitude of force between like particles, magnitude of "Majorana" force and of "Heisenberg" force between unlike particles, and the range of the forces are determined from the binding energy of the deuteron, the cross-section for neutron-proton scattering, the mass defect of ${}^3_1$H and the assumption that the force between like particles of opposite spin is the same as that between unlike particles. The calculations are carried out for different shapes of the interaction function. They yield a correct value for the energy difference between ${}^3_1$H and ${}^3_2$He but the binding energy of the α-particle comes out about 20% too high. R. P.

2873. Structure of Nuclei Beyond Oxygen. E. Wigner. *Phys. Rev.* 51. *pp.* 947–958, *June* 1, 1937.—An attempt is made to correlate the kinks in the mass defect curve with the energy differences between isobares, both as obtained from direct measurements and also from the shift of the isotopic number to higher values with increasing number of particles. Since the single-particle picture is known to be an insufficient approximation, the symmetry property of the wave function, resulting from the use of a symmetric Hamiltonian is utilised. The average interaction between symmetrically and antisymmetrically coupled particles (L+L′ and L−L′) is determined mainly from the kinks in the mass defect curve and enables one to calculate the energy differences between isobares. The energy change at the end of the shell is obtained from experimental data. It should enable one to get some idea of the probabilities with which the particles are in excited configurations. For heavier elements, the formula obtained here should naturally be identical with Weizsäcker's semi-empirical formula and the connection between both is discussed. AUTHOR.

2874. Statistical Theory of Nuclei. L. Landau. *Phys. Zeits. d. Sowjetunion*, 11. 5. *pp.* 556–565, 1937. *In German.*—It is shown that the formulæ derived by Bethe for the energy distribution of nuclear levels by means of the assumption that the nucleus is a perfect gas, may also be obtained from quite general considerations. A formula has now been derived for the determination of the breadth of the nuclear level and for that part which is concerned with scattering. The inelastic scattering of neutrons and the radiation of γ-quanta have also been investigated. H. H. Ho.

2875. Mass Defects of Light Nuclei from Recent Theories of Nuclear Forces. S. Flügge. *Zeits. f. Physik*, 105. 9–10. *pp.* 522–536, 1937.—The mass defects of the nuclei of masses 2, 3 and 4 are calculated on the basis of nuclear forces suggested by Volz [see following Abstract] and others. The possible stability of the hitherto undiscovered isotope H_4 is examined; application of the Hartree approximation indicates that it should be unstable and disintegrate with the emission of a neutron. F. C. C.

2876. Magnitude of Nuclear Forces. H. Volz. *Zeits. f. Physik*, 105. 9–10. *pp.* 537–552, 1937.—Mathematical treatment of nuclear forces based on the conservation of electric charge and on considerations of mass defect and of deuteron scattering leads to the combination and reduction of the four forces of Majorana, Heisenberg, Bartlett and Wigner to only two equations. [See preceding Abstract.] F. C. C.

2877. Interaction of Nuclear Forces in Heavy Nuclei. H. Euler. *Zeits. f. Physik*, 105. 9–10. *pp.* 553–575, 1937.—Using the Thomas-Fermi model, the mass defects of heavy nuclei are calculated approximately. Poor agreement is obtained using Hartree's method but consideration of a model of Bohr and Wigner on the basis of a treatment due to Volz [see preceding Abstract] leads to satisfactory results. F. C. C.

2878. Kinetic Energy and Free Path of Protons in Artificial Transmutations. G. Mano. *Comptes Rendus,* 204. *pp.* 1244–1246, *April* 26, 1937.—The free path of the protons in the reactions $^6\mathrm{Li} + {}^2\mathrm{H} \rightarrow {}^7\mathrm{Li} + {}^1\mathrm{H}$, $^{10}\mathrm{B} + {}^2\mathrm{H} \rightarrow {}^{11}\mathrm{B} + {}^1\mathrm{H}$, $^{12}\mathrm{C} + {}^2\mathrm{H} \rightarrow {}^{13}\mathrm{C} + {}^1\mathrm{H}$, and $^{14}\mathrm{N} + {}^2\mathrm{H} \rightarrow {}^{15}\mathrm{N} + {}^1\mathrm{H}$, deduced from the masses of the atoms as determined by Bainbridge and Jordan [*Phys. Rev.* 51. *pp.* 384–385, 1937] by the author's method [see Abstract 665 (1935)] agree with those determined experimentally by means of mica [see Abstract 3133 (1936)]. C. A. S.

2879. Deuteron-Deuteron Reactions. R. B. Roberts. *Phys. Rev.* 51. *pp.* 810–818, *May* 15, 1937.—Excitation curves for the two deuteron-deuteron reactions have been determined; the reactions are $D^2 + D^2 = He^3 + n^1$, and $D^2 + D^2 = H^1 + H^3$. The yield of neutrons in the first case is found for energies of bombardment between 40 and 300 kV, and the yield of protons in the second case between 40 and 300 kV, and the yield of protons in the second case between 40 and 100 kV. The most satisfactory target used was D_3PO_4. The yield of fast neutrons measured in the forward direction for a thick D_3PO_4 target bombarded by 100 kV deuterons was found to be equivalent to 44 mc. of Ra + Be per μA. The assumption of isotropic emission is made in calculating the results. The excitation curves for the two reactions coincide over the range 40–100 kV. The absolute yield of protons is found to be one proton per 6×10^6 deuterons after correcting for the stopping power of the target, but not for the anisotropy of the emission. No resonance is found in either excitation curve. G. O. B.

2880. Radioactivity Produced in Nickel by Deuteron Bombardment. R. L. Thornton. *Phys. Rev.* 51. *pp.* 893–896, *June* 1, 1937.—Ni bombarded with 5 eMV deuterons exhibits an intense positron activity of half-life $3 \cdot 4 \pm 0 \cdot 1$ hr. Chemical analysis shows this activity to be isotopic with Cu. The energy excitation curve for this reaction (proton capture) between 3 and 5 eMV has been obtained, and is found to be very different from that found for Cu (neutron capture). The variation with energy of the disintegration cross-section agrees satisfactorily with theoretical formulæ for the penetration of a deuteron into a nucleus of radius $4 \cdot 5 \times 10^{-13}$ cm. This result does not support the larger nuclear radii recently suggested by Bethe. The upper limit of the positron spectrum is approximately at $H\rho$ 4400 gauss-cm. AUTHOR.

***2881. Isotopic Analysis by Thermal Conductivity. N. R. Trenner.** *J. Chem. Phys.* 5. *pp.* 382–392, *June,* 1937.—A simple high pressure thermal conductivity gauge of good mechanical stability, freedom from poisoning effects and high accuracy is described in detail. Its physical characteristics are studied and optimum conditions for operation indicated. Its applicability to a wide variety of analyses is discussed and specific data quoted for those of the isotopic isomers of the lower aliphatic hydrocarbons and the hydrogens. Methods of direct calibration for the latter substances are indicated as well as a technique for their separation and purification. The theory of the gauge is developed and compared with experimental observations on the hydrogen isotopes. AUTHOR.

2882. Energetic Stability of Isobaric Nuclei. G. J. Sizoo. *Physica,* 4. *pp.* 467–472, *June,* 1937. *In English.*—The conditions for energetic stability of isobaric nuclei are formulated and applied to the isobaric sections of the energy surface, calculated with the semi-empirical formula of Bethe-Bacher-Weizsäcker. Out of 21 mass numbers only one pair of neighbouring isobaric nuclei was found to satisfy the stability conditions. If the first and the last of three isobaric nuclei with consecutive charge-numbers are stable, the second will in most cases be β-radioactive as well as capture-unstable. AUTHOR.

2883. Enrichment of the Argon Isotope A^{36} and Isotope Displacement Effect in the Spectrum of AI. H. Kopfermann and H. Krüger. *Zeits. f. Physik,* 105. 7–8. *pp.* 389–394, 1937.—By means of the Hertz isotope separation apparatus [see Abstract 15 (1935)] argon containing equal amounts of A^{36} and A^{40} is produced. An isotope displacement effect is clearly exhibited in the spectral lines of this argon sample. With the exception of the 1s$_2$-term, which has an appreciably greater displacement, the displacements of the terms investigated can be interpreted on the basis of Bohr's theory of the motion of the nucleus. J. E. K.

2884. Enrichment of the Light Argon Isotopes by Diffusion. H. Barwich and W. Schütze. *Zeits. f. Physik,* 105. 7–8. *pp.* 395–398, 1937.—With the Hertz isotope separation apparatus [see Abstract 15 (1935)] argon is produced, after 60 hours operation, in which the lighter isotopes ^{36}A and ^{38}A are increased in concentration from 0·06 % and 0·3 % to 0·5 % and 9·0 % respectively of the total element. This change in concentration is evidenced by a mass-spectrograph test. J. E. K.

2885. Ions and Isotopes. J. Kendall. *Roy. Soc. Edinburgh, Proc.* 57. 2. *pp.* 182–193, 1937.—Summary of work by the author and co-workers on the separation of ions by ionic migration. It is shown that although ionic mobility is controlled by ionic volume, the separation of the isotopes of light elements by fractional electrolysis can be brought about under suitable conditions and has resulted in the discovery of D$_2$. With two distinct ions of slightly different mobility, such as two rare earths, a complete separation was affected in a few days. The method seems to be applicable to the separation of Ra from Ba residues and should be useful in resolving mixtures of naturally occurring alkaloids. F. C. C.

2886. Neutron Yields from Artificial Sources. E. Amaldi, L. R. Hafstad and M. A. Tuve. *Phys. Rev.* 51. *pp.* 896–912, *June* 1, 1937.—Measurements of the total yields of neutrons obtained by bombarding D, Li, Be, and C with deuterons have been carried out in the voltage range 300 to 1000 kV, using the method of Amaldi and Fermi in which the neutron source is surrounded by a large tank of water. The energies of all neutrons are thus reduced to the order of thermal energies, and the total yield of neutrons is obtained by integration from measurements of the density of slow neutrons at various distances from the source. A rhodium detector was used. Comparison is made with the yield of neutrons from a Rn + Be source. The neutron yields per μA of D ions are shown in tabular form for each voltage in terms of mc. of Rn + Be to give the same neutron yield. Considerable space is devoted to discussion of the corrections to be applied to the experimental results and to the method of calculating them. The results for the bombardment of Li are doubtful on account of a faulty target, while those for D, which were obtained with a D$_2$O(P$_2$O$_5$) target, could be made more reliable by repetition with another target. G. O. B.

2887. Motion of Neutrons through Paraffin. L. S. Ornstein and G. E. Uhlenbeck. *Physica,* 4. *pp.* 478–486, *June,* 1937. *In English.*—A mathematical paper in which a general continuity equation for the time dependence of energy of distribution of particles going through matter is derived, and applied to the case of neutrons passing through paraffin, where the protons can be considered to be at rest. The equations for stationary distribution in space and in velocity is obtained, and the mean square displacement for neutrons with a given velocity computed. C. J. B. C.

*2888. **200-kV Neutron Source. C. M. Slack and L. F. Ehrke.** *Rev. Sci. Instruments,* 8. *pp.* 193–196, *June,* 1937.—A tube is described for the utilisation of the D – D reaction in the production of neutrons. A capillary arc ion source and a target of heavy ice are employed. The activation in Ag by the neutrons produced with 280 μA of unresolved ions at 200 kV was 10 times that obtained when a 200 mc. Rn-Be source was substituted. AUTHORS.

2889. X-Ray Interferometer Measurements in Halogen-Substituted Paraffins. H. Berger. *Phys. Zeits.* 38. *pp.* 370–379, *May* 15, 1937.—By the Debye method of making interferometer measurements on free gas molecules, investigations have been carried out on 1,2 dichloropropane, 1,3 dichloropropane, 1,5 dichloropentane, and 1,2 dibromoethane, with the Kα radiation of Cu. The experimental curves were compared with theoretical curves for the halogen atoms in the cis- and trans-positions. The results indicate that the hindrance to free rotation in the di-chlorine-substituted paraffins decreases with increasing length of the C chain. While with 1,2-$C_3H_6Cl_2$ the Cl atoms can only perform oscillations in the preferred trans-position, in the longer chains of the pentanes the rotation is practically unhindered. No results could be obtained in 1,2-dibromoethane; the investigations proving impracticable. However, on the basis of dipole measurements it can be concluded that the hindrance to free rotation increases if Br be substituted for Cl. G. O. B.

2890. Molecular Structure of Boron Trifluoride, BF_3. C. R. Bailey, J. B. Hale and J. W. Thompson. *Roy. Soc., Proc.* 161*A*. *pp.* 107–114, *July* 1, 1937.—The infra-red spectrum of BF_3 has been examined between 1 and 20 μ. The fundamental frequencies and some combination and overtones have been assigned. Comparison of the infra-red and Raman spectra shows the molecule to be planar and force constants have been calculated for $B^{11}F_3$ upon this assumption. From the force constants, the shifts to be expected in the fundamental bands due to the isotopic molecule $B^{10}F_3$ have been calculated and compared with the shifts observed. An estimate has been made of the radius of the B atom. AUTHORS.

2891. Molecular Structure of Carbon Disulphide. R. Titeica. *Soc. Roumaine Phys., Bull.* 38. 68. *pp.* 3–5, 1937. *In French.*—The infra-red spectrum of CS_2 shows an alternation in the appearance of the harmonics of the 6·56 μ band of this molecule. This phenomenon indicates that the molecule is linear and symmetrical, with the C atom equally distant from the two S atoms. AUTHOR.

2892. Values of Fundamental Atomic Constants. S. v. Friesen. *Roy. Soc., Proc.* 160*A*. *pp.* 424–440, *June* 1, 1937.—The present paper gives a survey of the experimental work concerning the constants *c*, *e/m*, *e*, and *h*, the values given with their limits of error arising from attempts to indicate the narrowest regions within which the time values may be found. The data are as follows: *c*, the velocity of light in vacuum = 299·780 ± 20 km./sec.; *e/m*, the specific charge of the electron = (1·7585 ± 0·002) × 10^7 e.m.u./gm.; *e*, the electronic charge = (4·800 ± 0·005) × 10^{-10} e.s.u.; *h*, Planck's constant = (6·610 ± 0·015) × 10^{-27} erg. sec. M_H, mass of H atom, is based upon the determination of Avogadro's number (6·028 ± 0·008) × 10^{23} and is found to be (1·673 ±

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0·003) × 10^{-24} gm. Sommerfeld's fine structure constant $2\pi e^2/hc$ is a pure number, which according to Eddington's hypothesis has an inverse value exactly equal to 137; with the above values for the constants the value becomes 136·9, which, within the limits of error, agrees with the hypothetic value. H. H. Ho.

See also Abstracts 3037, 3096, 3126, 3131, 3138, 3149, 3154, 3196, 3206, 3228.

COLLOIDS.

2893. Sedimentation Equilibrium of Colloids in the Ultracentrifuge. T. Katsurai. *Kolloid Zeits.* 78. *pp.* 30–31, *April*, 1937.—A simplified equation for equilibrium conditions, viz. $s\omega^2xc - k.dc/dx = 0$, in which s is the sedimentation constant (involving the molecular weight of the suspensoid) and the other symbols have the usual significance, is derived from a slight modification of Lamm's general equation [see Abstract 20 (1937)]. Satisfactory agreement with experiment is found in the case of phycoerythrin (Svedberg's data). L. V. C.

2894. Measurement of Particle-Size Distribution by Optical Methods. H. E. Schweyer. *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 211–212, *May* 15, 1937.—A brief study was made of the effect of light of different wave-lengths upon the turbidity-concentration relation of aqueous suspensions of white and coloured mineral powders using the Wagner turbidimeter. It was found that yellow and red light gave about the same slope as white light for a plot of concentration against turbidity, but that green light yielded a curve that diverged from white light in the region of low concentration. This indicates that the suspensions tend to absorb the shorter wave-lengths, thereby affecting the output of the photo-cell with an attendant influence on the particle-size distribution as measured by this method. AUTHOR.

2895. Filtering of Liquid Suspensions by Porous Media. W. N. Arnquist. *J. of Applied Physics*, 8. *pp.* 363–367, *May*, 1937.—The filtering through a Berea sandstone of both circulated and stagnant thixotropic water-mud (1·5 gm./ml.) was investigated experimentally in connection with the control of drilling for oil. The water-mud was made with commercial Baroid containing 5% bentonite by weight of total solids. A pressure of 80 lbs./in². was applied. Without circulation the square of the volume of penetrating liquid was proportional to time, in accordance with theoretical considerations. Circulation impeded the growth of the filter pack in the stone beyond about 1 mm. in thickness. Water appeared to cause a swelling of the bonding material of the stone. Mud particles found their way through several cm. of rock and the particles were distributed uniformly in the pore spaces. After mudding, permeability to water depended on the distribution of the particles in the pore spaces, which was governed by the flow history after mudding. P. H. B.

2896. Dispersity of Aerosols. N. Fuchs. *Acta Physicochimica*, 6. 2. *pp.* 143–160, 1937. *In German.*—A comparative survey, with references, of existing methods applicable to mists, smokes, dusts, etc., classified as follows (1) microscopic and macroscopic methods for determining terminal velocities in electrical, gravitational and centrifugal fields, (2) microscopic and macroscopic diffusion methods, (3) weighing methods (as in sedimentation), (4) direct microscopy, (5) special optical methods ("corona," X-ray and electron diffraction, tyndallimetry). L. V. C.

See also Abstracts 3049, 3056, 3228.

CRYSTAL STRUCTURE AND PROPERTIES.

2897. Lattice Theory of Alkaline Earth Carbonates. B. Y. Oke. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 326–328, *April*, 1937.—The paper contains corrections and modifications of the results already described. [See Abstract 996 (1937).] C. A. S.

2898. Crystal Polymorphism. M. C. Bloom and M. J. Buerger. *Zeits. f. Krist.* 96. 5. *pp.* 365–375, 1937. *In English.*—Certain types of impurities present in solution during precipitation of a solid phase often generate an "unstable" polymorphous modification. The modification thus generated often contains this impurity, sometimes held so tenaciously as to defy usual chemical treatment for its removal. Under these conditions, the structure containing this impurity shows a remarkable resistance to transformation to the stable structure of the pure substance. The complete removal of the impurity is apparently necessary for the realisation of the transformation. Available evidence indicates that the phenomenon is a very general one, appearing with organic as well as with inorganic compounds. This behaviour is in accord with conclusions recently reached upon the basis of theoretical considerations [see Abstract 1901 (1937)]. In the precipitation of Sb_2O_3 from aqueous solution, chloride and sulphate are very effective in thus stabilising the high temperature structure. Perchlorate has a comparatively feeble stabilising effect. AUTHORS.

2899. Charge Distribution in a Space Lattice. V. A. Johnson. *Zeits. f. Krist.* 96. 6. *pp.* 493–496, 1937. *In English.*—It is generally assumed that the forces holding a solid body together are of an electrical nature and that their direction in the solid is determined by the symmetry properties of the crystal. The various problems have then been solved on the assumption that charged particles are located at the points of a space lattice, the symmetry of which will change from substance to substance. The trigonometric expansions which are then derived have never been proved to be convergent, and the present author has now worked out a proof of convergence by treating the problem in a way similar to Riemann's treatment of the Green's function of a rectangular parallelepiped. The paper is entirely mathematical. H. H. Ho.

2900. Review of X-Ray Diffraction Methods. J. T. Norton. *J. of Applied Physics*, 8. *pp.* 307–312, *May*, 1937.—An illustrated review under the heads: (1) Lattice Type and Size; (2) Crystal Orientation; (3) Grain Size; (4) Crystal Distortion. The importance is stressed of careful manipulation and interpretation, preferably by someone who can resolve metallurgical problems into physical fundamentals. D. R. H.

2901. Structures of Ni_2Al_3 and $NiAl_3$. A. J. Bradley and A. Taylor. *Phil. Mag.* 23. *pp.* 1049–1067, *June*, 1937.—Ni_2Al_3 is trigonal, space-group D_{3d}^3 (C3*m*). There are two Ni and three Al atoms in the unit cell, of which the dimensions are $a = 4 \cdot 0282$ Å, $c = 4 \cdot 8906$ Å, $c/a = 1 \cdot 2141$. The Al atoms lie at the corners of a deformed cube, and the Ni atoms are very near to the centres of two-thirds of these pseudo-cubes. One-third of them are empty. $NiAl_3$ is orthorhombic, space-group D_{2h}^{16} (P*nma*); $a = 6 \cdot 5982$, $b = 7 \cdot 3515$, $c = 4 \cdot 8021$ Å. The unit cell contains 4 Ni and 12 Al atoms arranged in a peculiar type of close-packing. The Ni atoms and 4 of the Al atoms form distorted hexagonal nets lying in the mirror planes of the structure. The other 8 Al atoms are to be found almost midway between these planes. The interatomic distances Ni–Al are almost the same in NiAl, Ni_2Al_3, and $NiAl_3$ (2·42–2·49 Å); these are much smaller than the sums of the atomic radii. The Al-Al distances are on the average about the same as in the element (2·86 Å). AUTHORS.

2902. Identification of Submicroscopic Crystal Faces by Electron Diffraction. M. v. Laue. *Ann. d. Physik,* 29. 3–4. *pp.* 211–238, *June,* 1937.—The abnormal diffraction effects obtained by Cochrane [see Abstract 4473 (1936)] and Brück [see Abstract 2977 (1936)] from thin single-crystal films of Co, Ni and Ag are discussed in terms of crystal-form-factors and the atomic positions occupied in the observed surfaces. It is suggested that in Cochrane's Co specimens submicroscopic octahedral boundary faces projected from the macroscopic (110) face to about 6×10^{-7} cm., but that all the atomic positions in the uppermost layer were occupied, and not only a quarter as would be expected if the lattice were built up from face-centred cubes. In the case of Ni only two of the four octahedral planes appeared as boundary faces, and the metal surface therefore possessed a corrugated structure (*Wellblechstruktur*). Here also the top layer was completely filled, but in contrast to Co, distinct lattice defects occurred at the junction of the (111) and $(11\bar{1})$ boundary faces. It is claimed that Brück's results can be similarly explained, but that cube faces, as well as octahedral planes, appear as limiting faces as soon as periodic lattice defects occur, the cube face attaching itself to four octahedral faces. A. G. Q.

2903. Effect of Cold Working on Structure in Alloys. U. Dehlinger. *Zeits. f. Physik,* 105. 9–10. *pp.* 588–594, 1937.—The effect of cold working in destroying the ordered arrangement of atoms in alloys is explained quantitatively in the light of Jones' electronic theory, the cases of CuPd and AuCu being particularly considered. L. A. W.

2904. Crystal Parameters of Osmium and Ruthenium at Different Temperatures. E. A. Owen and E. W. Roberts. *Zeits. f. Krist.* 96. 6. *pp.* 497–498, 1937. *In English.*—The sides a of the unit cells of Os and Ru were measured at intervals of 50° from 50° to 600°, and also at 20° and 80°. They increase respectively from $2·7298_0$ and $2·6984_4$ at 20° to $2·7375_0$ and $2·7089_7$ at 600°; and the ratio a/c from $1·5790_1$ and $1·5835_3$ at 20° to $1·5810_0$ and $1·5867_1$ at 600°. The mean linear coefficients thence deduced ($\times 10^6$) at 50° are 4·8 for Os and 6·9 for Ru, and at 550° 6·9 and 8·8 [see Abstract 3958 (1936)]. C. A. S.

2905. Polymorphic Transitions of Inorganic Compounds to 50,000 kg./cm². P. W. Bridgman. *Nat. Acad. Sci., Proc.* 23. *pp.* 202–205, *April,* 1937.—A preliminary survey is given of an investigation, over a temperature range of −79° to 200°, by a new high pressure technique [see Abstract 54 (1936)], of the polymorphism of 35 compounds for which transition parameters (pressure, temperature, change of volume, and latent heat) are tabulated. The case of 15 others for which the transitions are sluggish or obscure or for which the variation of the parameters is very large is outlined. A general discussion of a statistical study of available data is given. N. M. B.

2906. Structure of Selenium Dioxide. J. D. McCullough. *Am. Chem. Soc., J.* 59. *pp.* 789–794, *May,* 1937.—By means of an X-ray investigation, sublimed SeO_2 is shown to crystallise in the tetragonal system with unit edges $a_0 = 8·353 \pm 0·005$ Å and $c_0 = 5·051 \pm 0·010$ Å. The unit of structure contains 8 Se and 16 O atoms in the following positions of the space group D_{4h}^{19}: 8Se in 8h with $x = 0·133$ and $y = 0·207$; $8O_I$ in 8g with $x = 0·358$; and $8O_{II}$ in $8h = 0·425$ and $y = 0·320$. The structure consists of chains of alternating Se and O atoms along the *c*-axis, with O of a second kind bonded to each Se atom. The observed separations are 1·78 ± 0·03 Å for Se–O_I and 1·73 ± 0·08 Å for Se–O_{II} with bond angles of 98 ± 2° for O_I–Se–O_{II}, 90° ± 30′ for O_I–Se–O_I and 125° ± 30′ for Se–O_I–Se. AUTHOR.

2907. Structure of Calcium Sulphate Hemihydrate. W. Büssem and P. Gallitelli. *Zeits. f. Krist.* 96. 5. *pp.* 376–380, 1937.—Arguments are adduced, based largely on the discrepancy between the experimental density and that calculated by Caspari, against his view as to the structure of $CaSO_4 \cdot \frac{1}{2}HO$ [see Abstract 2507 (1936)]. These arguments are supported by redeterminations of some of the author's previous results and negative the supposed trigonal and support the monoclinic structure. Absence of any polysynthetic twinning is definitely shown. C. A. S.

2908. Crystal Lattice of Calcium Iodate and Its Relation to that of Potassium Iodate. B. Gossner. *Zeits. f. Krist.* 96. 5. *pp.* 381–384, 1937.—KIO_3 has a cubic lattice and the author shows that it is possible to choose from this lattice a monoclinic cell which has approximately the same shape and dimensions as that of $Ca(IO_3)_2$. When allowance is made for the smaller radius of the Ca-ion the agreement between the observed cell of $Ca(IO_3)_2$ and the one constructed from the cubic lattice of KIO_3 is much closer. This *constructed* cell satisfies the valency conditions of all the atoms. J. I.

2909. Sulphate and Phosphate with Similar Crystal Lattices. B. Gossner. *Zeits. f. Krist.* 96. 6. *pp.* 488–492, 1937.—The similarity in structure between certain sulphates and phosphates (or arsenates) of similar composition is shown by comparing (suitable axes being selected) gypsum $CaSO_4 \cdot 2H_2O$ (*a* 10·47, *b* 15·15, *c* 6·28, *β* 98° 58′, *z* (no. of mols. in unit cell, 8) with pharmacolite, $CaHAsO_4 \cdot 2H_2O$ (*a* 10·97, *b* 15·40, *c* 6·29, *β* 96° 36′, *z* 8); and alunite $K[Al(OH)_2]_3S_2O_8$ (*a* 7·05, *α* 59° 2′, *z* 1, space group D_{3d}^5) with hamlinite $Sr[Al(OH)_2]_3\ HP_2O_8$ (*a* 6·82, *α* 61° 28′, *z* 1, space group $3C_{3v}^5$). The structures are discussed in some detail and the arrangement of the group SO_4–K–SO_4 in the lattice shown to correspond with that of PO_4–Sr–$PO_3(OH)$. C. A. S.

2910. Structure of Aluminium Metaphosphate, $Al(PO_3)_3$. L. Pauling and J. Sherman. *Zeits. f. Krist.* 96. 6. *pp.* 481–487, 1937. *In English.*—On the basis of certain assumptions regarding the coordination polyhedra in the cubic crystal $Al(PO_3)_3$, a structure is formulated which accounts satisfactorily for the observed X-ray data. The unit cube, with $a_0 = 13 \cdot 63$ Å, contains 16 $Al(PO_3)_3$ in the following positions of the space group $T_d^6 - \overline{1}43\,d$:

16 Al in 16c with $u = 0 \cdot 117$;
48 P in 48e with $x = 0 \cdot 340$, $y = 0 \cdot 063$, $z = 0 \cdot 124$;
48 O_I in 48e with $x_I = 0 \cdot 090$, $y_I = 0 \cdot 110$, $z_I = 0 \cdot 800$;
48 O_{II} in 48e with $x_{II} = 0 \cdot 095$, $y_{II} = 0 \cdot 141$, $z_{II} = 0 \cdot 245$;
48 O_{III} in 48e with $x_{III} = 0 \cdot 137$, $y_{III} = 0 \cdot 096$, $z_{III} = 0 \cdot 986$.

The crystal contains complexes P_4O_{12} consisting of four PO_4 tetrahedra with P – O = 1·51 Å, each of which shares two corners with other tetrahedra and the other two corners with AlO_6 octahedra. Each AlO_6 octahedron (with Al – O = 1·83 Å) shares its six corners with six surrounding P_4O_{12} complexes. The structure of the metaphosphate group in this crystal (the first metaphosphate analysed) is closely similar to that of the metasilicate group in various metasilicates. AUTHORS.

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19

2911. Crystal Structure of Bornite. D. Lundqvist and A. Westgren. *Arkiv f. Kem. Min. och Geologi, Stockholm,* 12*B*. *No.* 23. [6 *pp*.], 1937. *In English*.—The formula of bornite is proved to be Cu_5FeS_4, and space group O_h^7, 8 mols. in unit cell. It seems certain that the S atoms are all equivalent and arranged in cubic close packing, and that the 8 Fe atoms are arranged definitely in one of the two 8-fold positions. But as regards the Cu atoms observed and calculated intensities do not agree if they are assumed to fill all the places required by any possible definite set of positions. It is therefore suggested that definite positions can be assigned to at least 24, while of the remaining 16 some at least are placed arbitrarily among two other sets, each of 16 positions. C. A. S.

***2912. Crystal Behaviour of Hydrocarbons. R. T. Leslie and W. W. Heuer.** *Bureau of Standards, J. of Research,* 18. *pp*. 639–644. *June,* 1937.—The construction and operation of a microscope for the observation of the growth of crystals at low temperatures are described. Photomicrographs of nine aromatic, six cycloparaffinic, eight normal paraffinic, and five branched-chain paraffinic hydrocarbons of known structure were obtained. It is shown that successive members of the homologous series of normal paraffins do not differ in crystal appearance. It is observed, however, that condensed molecules tend to crystallise in polyhedra of about equal dimensions, whereas molecules with long chains tend to form long prisms. Mixed molecules show modified forms depending on the relative influence of the chain and the condensed groups. AUTHORS.

2913. Structures of Mercury *n*-Alkyl Mercaptides. A. F. Wells. *Zeits. f. Krist.* 96. 6. *pp*. 435–450, 1937. *In English*.—The mercury mercaptides, from the ethyl to the *n*-octyl member, are examined. With the exception of the butyl and octyl compounds they form a monoclinic isomorphous series. The butyl compound is tetragonal, $a = 26{\cdot}9$, $c = 13{\cdot}9$ Å, with 32 molecules per cell and space-group $I\,4_1/a$. The octyl mercaptide is triclinic, pseudo-monoclinic. A structure is proposed for the ethyl mercaptide based on a pseudo-centro-symmetrical molecule which is placed in the 4-fold general position of *Cc*. The S-Hg-S bonds are colinear, the approximate positions of the sulphur atoms being obtained from a Fourier projection on (010). The changes in symmetry which occur at the butyl and octyl mercaptides may be predicted from the structure of the ethyl mercaptide. It is shown that the feature common to all these monoclinic mercaptides is the projection on (010), but the heights of the molecular centres relative to this projection (i.e. the *y* parameters) vary considerably in the different compounds. AUTHOR.

2914. Birefringence of Liquid Crystals. P. Chatelain. *Comptes Rendus,* 204. *pp*. 1352–1353, *May* 3, 1937.—The birefringence of films of certain liquids enclosed in glass varies considerably with temperature owing to the thermal agitation of the molecules which oscillate about equilibrium positions fixed by the action of the walls and molecular fields. A small-angled prism formed in this way gave parallel equidistant fringes up to 0·7 mm. thickness showing the retardation is proportional to the thickness. With fields up to 20,000 gauss no displacement of the fringes could be observed showing the birefringence was altered by $< 1/4000$. H. G. C.

2915. Rhythmic Crystallisation in Slags. F. Roll. *Kolloid Zeits.* 79. *pp*. 221–222, *May,* 1937.—The formation consists of alternate layers of light and dark grey rings in which pseudowollastonite ($CaSiO_3$)

and gehlenite (2CaO·Al$_2$O$_3$·SiO$_2$) respectively predominate, in a green glassy slag from an iron foundry. Crystallisation occurs slowly at 800°, rapidly at 950°. Microphotographs and analyses are given. C. A. S.

2916. Distinction of Right- and Left-Handed Structures in Crystals by Laue-Patterns. J. ter Berg and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 40. 3. *pp.* 406–410, 1937. *In English.*—The prevalent opinion that according to the Friedel principle of the superimposition of a centre of symmetry on the true symmetry of the crystal, when the latter is radiated through by X-rays, it is impossible to distinguish the dextro- and the laevogyratory crystals of optically active substances from Laue-patterns, is now shown to be wrong generally, and that by a suitable arrangement of the experimental conditions the distinction may be made in certain cases, of which the Co, Cr and Rh salts are examples. A general review of the problem is now given and the method is found to be applicable where the crystals have a polar axis. H. H. Ho.

2917. Nucleus Formation and Recrystallisation. Parts IV and V. M. Kornfeld and A. Schamarin. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 297–306, 1937. *In German.*—The relation between the structure of a material after recrystallisation and the initial plastically deformed material is usually given as $n(\omega) = v(\omega) \times c\ (\omega)$, where $n(\omega)$ represents the distribution of new grains, $v(\omega)$ the distribution throughout the volume of the original material and $c(\omega)$ the relation between the relative velocities of formation of nuclei and the orientation. This expression is discussed and certain deductions from it are tested experimentally by measurements on Al wires. The effect of " recovery " on the velocity of formation of nuclei is then described for Al single crystals. Work has already been done on polycrystalline Al [see Abstract 470 (1937)] and the results for single crystals show that, in them, the effect has the opposite sign, although qualitatively the observed phenomena are identical. The difference in sign is attributed to quantitative differences in structure. H. J. H. S.

2918. Crystal Habit of Ammonium Azide, NH$_4$N$_3$. W. Kleber. *Zeits. f. Krist.* 96. 5. *pp.* 386–389, 1937.—Small colourless needles are obtained which are shown to be tetragonal though they do not resemble very closely other similar tetragonal azides. The axial ratios are, $a : b : c = 0{\cdot}788 : 1 : 1{\cdot}056$. J. I.

2919. Sulphur-Iodide Crystals RI$_3$·3S$_8$: Structure Unit and Optical Properties. C. D. West. *Zeits. f. Krist.* 96. 6. *pp.* 459–465, 1937. *In English.*—A detailed examination of the crystal habit of CHI$_3$·3S$_8$ and AsI$_3$·3S$_8$ is described. The Laue symmetry is D_d, the simplest unit being a rhombohedron containing one formula RI$_3$·3S$_8$. The refractive indices are given in a table which includes values for both compounds for various wave-lengths. The refractive indices of CHI$_3$ crystals are also given. From these values and those for AsI$_3$ and the S$_8$ molecule the author finds that the molecular refractions in RI$_3$·3S$_8$ crystals are additive and so concludes that the S$_8$ molecules must lie with their planes parallel to the basal plane of the crystals. J. I.

2920. Distribution of Angular Values in Crystals. I. I. Schafranowski. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 6. *pp.* 377–380, 1937. *In French.*—Certain coincidences in the distribution of the angular values of the various forms observed on crystals are pointed out. The constant recurrence of the angle 54° 44′ and values approximating to this appears according to the author to have some special significance in the building up of crystals. He further points out that in considering the hydrodynamical problem of two spheres moving in a liquid the angle 54° 44′ again has a special significance. It is suggested that this coincidence points to an analogy between the hydrodynamical problem and that of the formation of crystal as from ions or atoms in solution. J. I.

2921. Surface Phenomena in Crystallisation of Under-Cooled Liquids in Thin Layers. G. L. Michnewitsch, J. F. Browko and A. B. Babadshan. *Acta Physicochimica,* 6. 3. *pp.* 455–472, 1937. *In German.*—The authors first investigate the distribution of crystallisation nuclei in thin layers of under-cooled liquids. The substance is melted between two cover-glasses and curves are given showing how the distribution of nuclei varies according to the previous history of the substance. Various theoretical considerations relating to these distributions are then discussed. It is further shown that the distribution of nuclei is affected by the application of an electric field either parallel to the layer or normal to it. J. I.

2922. Shadow Experiment on the Vibration of a Thin Quartz Sheet. W. Schaaffs. *Zeits. f. Physik,* 105. 9–10. *pp.* 576–578, 1937.—Using the *schlieren* method, the vibration of a thin quartz plate immersed in xylol is examined. Progressive changes in the nature of the vibration pattern are observed as the exciting frequency is varied. F. C. C.

***2923. Integrating Photometer for X-Ray Crystal Analysis. R. H. V. M. Dawton.** *Journ. Sci. Instrunents,* 14. *pp.* 198–200, *June,* 1937.—Some improvements in the integrating photometer [see Abstract 4148 (1933)] are described; mainly the substitution of a mechanical clutch with a magnetic release, for the original magnetic clutch. AUTHOR.

2924. Quantitative Determination of Lattice Distortion. R. Brill. *Zeits. f. Physik,* 105. 5–6. *pp.* 378–388, 1937.—A method for the quantitative determination of the lattice distortion in a lattice composed of atoms all of one kind, is outlined. The method depends on the comparison of the intensities of the various lines in the X-ray powder photograph of the distorted material with those of the corresponding lines in the photograph of the undistorted material. It is applied to the case of Fe. In an Appendix the method is extended to the case of a lattice of the rock-salt type, in which two kinds of atom occur. J. T.

2925. Absorption and Weissenberg Photographs. A. F. Wells. *Zeits. f. Krist.* 96. 6. *pp.* 451–453, 1937. *In English.*—The intensities of spots on single crystal X-ray photographs are sometimes affected by absorption of the X-rays in the crystal, which makes it important to know which reflections will be seriously influenced. It is shown for Weissenberg photographs that the spots so affected lie on one of two lines which are the diagonals of the Weissenberg chart. C. J. B. C.

2926. Hollow Canals in Calcite. P. J. Holmquist. *Arkiv f. Kem. Min. och Geologi, Stockholm,* 12*A*. *No.* 10 [16 *pp.*], 1937. *In German.*—The various types of canals described in the literature are discussed in detail and several specimens of calcite are described in which these canals can be observed. Photographs of some of the specimens are reproduced. From an examination of many specimens the author concludes that only exceptionally can distinct parallel gliding of the lamellæ be seen and the displacements cannot be explained on the assumption of simultaneous gliding of lamellæ across one another. Other explanations of the origin and form of the canals are put forward. J. I.

See also Abstracts 2871, 2936, 3081, 3120, 3121, 3169, 3181, 3187, 3217, 3222.

DENSITY.

2927. Partial Molal Volume of H_2O and D_2O in Dioxan Solution. R. A. Robinson and R. P. Bell. *Faraday Soc., Trans.* 33. *pp.* 650–652, *May*, 1937.—From density measurements (25°) on dioxan solutions with 0–17 % solute the apparent molal volume of H_2O is, over the whole range, about 0·5 % lower than that of D_2O; this difference is of the order expected from the calculated difference in zero point energy. L. V. C.

See also Abstracts 3135, 3181.

DIFFUSION AND OSMOSIS.

2928. Thermal Diffusion of Radon Gas Mixtures. G. E. Harrison. *Roy. Soc., Proc.* 161*A*. *pp.* 80–94, *July* 1, 1937.—Experiments on the thermal diffusion of Rn-H_2 and Rn-He gas mixtures are described. Rn was the rare and heavy constituent of these mixtures, the original proportion by volume of Rn varying, in different experiments, from 1·2 to $2 \cdot 2 \times 10^{-6}$. The temperature of the hot side was 100° C., and that of the cold side 0° C. A differential, γ-ray method was used, so that the difference in the quantity of Rn on the cold and hot sides, due to thermal diffusion, could be obtained directly, and from this the ratio of the proportion by volume of Rn on the cold to that on the hot side was calculated. The special theory due to Chapman (1929), of thermal diffusion of rare constituents in gas mixtures was then used to evaluate the repulsive force index, s_{12}, between these two pairs of molecules from the experimental results. The mean value obtained for the ratio of the proportion by volume of Rn on the cold to that on the hot side, after thermal diffusion, was 1·10 for Rn-H_2 mixtures, and 1·22 for Rn-He mixtures. The calculated value of s_{12} was 6·3 for Rn-H_2 molecules, and 7·3 for Rn-He molecules. A comparison between the results of the present series of experiments and those of Ibbs and Grew [see Abstract 2144 (1931)] shows that the Rn molecule must be very "soft." The revised values of s_{12} obtained by Ibbs and Grew for the following pairs of molecules are: H_2-Ne (10·3), H_2-A (7·3), He-Ne (11·4), and He-A (9·0). AUTHOR.

2929. Diffusion Phenomena and Temperature Fields in the Solidification of Melts. J. Müller-Strobel. *Zeits. f. Krist.* 96. 6. *pp.* 466–480, 1937.—A theoretical discussion of the various phenomena which occur during the solidification of melted substances, especially at the surface of molten metals. Expressions are derived for the concentration fields under varying conditions of solidification. J. I.

2930. Theory of Osmotic Pressure and the Ulmann Method of Measurement. K. Wohl. *Zeits. f. phys. Chem.* 179. *Abt. A.* 3. *pp.* 195–209, 1937.—The author discusses the influence of external pressure and of the gravitational field on the osmotic pressure of a solution and demonstrates that the effect which arises gives no indication of distinguishing in Thiel's sense between an excess or deficiency pressure conception of the osmotic pressure. The case considered by Thiel that equilibrium between solution and solvent is obtained through the exertion of a force upon the solvent adhering to a membrane is realised in the Ulmann process of isothermal distillation. The *rôle* of the membrane in these experiments is explained on the simple conception that it is a system of capillary tubes. The force with which the solvent breaks away from the membrane, and the remarkable reduction in distillation velocity between solution and solvent are found to be approximately independent of temperature between 18° and 80° C. H. H. Ho.

2931. Osmotic Pressure and Gas Pressure. K. Fredenhagen. *Zeits. f. Elektrochem.* 43. *pp.* 415–421, *June*, 1937.—This paper is a reply to that of K. H. Meyer [see Abstract 1486 (1937)] and maintains the opposing view that there is a fundamental difference in character between osmotic pressure and gas pressure. Osmotic pressure, defined as the experimentally observable pressure difference between solution and solvent when separated by a semi-permeable membrane, is completely analogous to vapour pressure difference. It is shown that van't Hoff was in error in identifying osmotic pressure with an excess pressure exerted by the thermal agitation of the solute molecules. Vapour pressure difference and osmotic pressure can never be caused by the mere presence (*i.e.* by the thermal impacts) of solute molecules, but can only occur when the process of solution results in a modification of the properties of the solvent. The mechanical recoil theory supported by Meyer is at variance with fundamental thermodynamical principles. L. A. W.

See also Abstracts 2883, 2884.

ELASTICITY AND PLASTICITY.

2932. Stress Components in Two Dimensions in an Aeolotropic Substance. H. Ôkubo. *Tohoku Univ., Sci. Reports,* 25. *pp.* 1110–1120, *March*, 1937. *In English.*—In this paper, using the fundamental properties of the stress-function in an aeolotropic substance due to K. Wolf [see Abstract 4833 (1935)] the general solution of stress components in two-dimensional aeolotropic substance is obtained and some useful technological problems are also treated. The process of this treatment is far simpler than that of the previous investigator. AUTHOR.

2933. Elastic Constants of Quasi-Isotropic Mixtures of Isotropic Substances. D. A. G. Bruggeman. *Ann. d. Physik,* 29. 2. *pp.* 160–178, *May*, 1937.—The author's theory of dielectric constant and conductivity of quasi-isotropic substances [see Abstract 2359 (1936)] is extended to the elastic constants. Formulæ analogous to those of Wiener and Lorentz-Lorenz for the dielectric constant are deduced for the various moduli of an assemblage of lamellæ and for a homogeneous substance with spheres of another substance distributed within it. Mixtures of lamellæ and mixtures of spheres are also considered. The theory leads to the conclusion that for a homogeneous substance containing spheres of another substance within it the Young's modulus may pass through a maximum at a certain composition of the mixture, and experimental data on certain kinds of concrete are adduced in confirmation of this. L. A. W.

2934. Theory of Shells. V. Sokolovskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 8. *pp.* 483–486, 1937. *In English.*—The equations for axially symmetrical elastic shells may, in certain cases, be reduced to a set of second order equations. The catenoid is shown to be one such, and the functions occurring in the analytical solution in this case are determined. W. G. B.

2935. Compressibility of Fused-Quartz Glass at Atmospheric Pressure. W. B. Emerson. *Bureau of Standards, J. of Research,* 18. *pp.* 683–711, *June*, 1937.—The compressibility of fused-quartz glass was determined with sufficient accuracy to establish the required corrections for change of length with change of pressure of the fused-quartz glass étalons used in a Fabry-Perot interferometer to evaluate the indices of refraction of air for converting standards of wave length in air to their value *in vacuo.* Compressibility determinations were made for the same changes of pressure that were used for index measurements; namely, from vacuum to atmospheric pressures. Determination of the compressibility of fused-quartz glass was made by interferometric comparison of the relative change in length of end gauges of fused quartz and stainless steel. Values for the compressibility of both fused quartz and stainless steel were also determined by a direct method which depended upon the relative change in length of a closed tube and a solid gauge of the same material. By this method the compressibilities of fused quartz and of a stainless steel were determined independently, thereby eliminating the existing uncertainty as to the compressibility of steel at atmospheric pressure obtained by extrapolation from much higher pressures and eliminating, also, the necessity for comparison of materials with great difference in thermal expansivity. Relative values for fused quartz and stainless steel were also derived from comparative changes in length with pressure of tubes and gauges of dissimilar materials. The measurements gave the following values for longitudinal compressibility at 1 atmos. pressure: For fused-quartz glass $9 \cdot 9 \times 10^{-7} \pm 5 \times 10^{-8}$ per atmos. For a sample of stainless steel $\ll 3 \cdot 1 \times 10^{-7}$ per atmos. AUTHOR.

2936. Flow in Highly-Stressed Metals. P. W. Bridgman. *J. of Applied Physics,* 8. *pp.* 328–336, *May,* 1937.—Force-pressure values are plotted for very thin discs of material rotated through 60° between two hardened alloy-steel surfaces under pressure. For a thickness of 0·002 cm. the shearing distortion at the edge is 150 radians. In almost all curves there is a knee, marking the transition from surface slip to internal slip, but in general the curve does not become horizontal. The mechanisms of slip in solids and liquids are essentially different. Single and polycrystalline specimens are considered theoretically. After the specimen has reached a steady state during rotation, hysteresis effects may or may not occur on reversal in Pb the steady state is reached only after 100 double rotations. Salts, Sr, Ce, hexagonal Ti, As, and Os show a snapping effect on rotating, but some common brittle metals—*e.g.*, Zr, Mo, Ta, W, become ductile at high pressures. Graphite and quartz glass do not appear to yield at all by plastic flow. Probably Sr and Ce show lattice transformations under pressure. Cubic metals probably do not rupture internally. Shearing stress appears to be the force needed to maintain constant flow. Self-welding is almost universal, and under the conditions of test, surface imperfections can play little part since lines of flow are closed curves. [See Abstract 1497 (1937)]. D. R. H.

2937. Generation and Propagation of Elastic Waves. Z. Kinosita. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 41–49, *March,* 1937.—Some cases of the propagation of torsional waves along wires loaded at equal intervals with wooden cross-pieces are studied experimentally, the waves being generated either by relaxing constraints or by applying impulses. The wave is measured at several points along the wire, and, allowing for the dissipation (mainly due to air resistance to the wooden loads), the kinetic energy of the wave is equal to the potential energy before relaxation, or to that supplied by the impulse. W. G. B.

2938. Propagation of Waves. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 297–328, *April,* 1937. *In English.*—The paper is concerned with the mathematical solution of a rather general partial

V.4
193

differential equation of hyperbolic form, with two independent variables, x and t, representing the propagation of waves in one dimension. In the cases considered, the characteristics are two real straight lines. A double integral is used of the Fourier-Mellin type, with a kernel which depends on the coefficients in and solutions of the ordinary differential equations obtained by substituting a product of a function of t alone and a function of x alone for the dependent variable. The integral is divided into parts which represent respectively the waves travelling in each of the two directions, and the wave tail. The equations of motion of a stretched string, and the telegraph equation, with given initial conditions, are considered as examples, the region considered so far being infinite. The author proceeds to consider the modification for a finite region, with given boundary conditions, and shows how his treatment of the double integral may be used to obtain the solution either in the form of standing waves, or in the form of progressive waves, with reflections from the boundaries. S. G.

2939. Frequency of Transverse Vibrations of a Loaded Bar. Part IV. R. M. Davies. *Phil. Mag.* 23. *pp.* 1129–1145, *June*, 1937.—The effect of shear strain is examined by methods similar to those used in the previous papers [see Abstract 1932 (1937)]. The effect upon the experimental values given in previous papers is of the order of 0·2 %. W. G. B.

*2940. **Accurate Measurement of Gas Pressures. F. Kretzschmer.** *Arch. f. Wärmewirtsch.* 18. *pp.* 141–144, *May*, 1937.—Instruments and methods are described by means of which small gas pressures can be measured in terms of the displacement of a liquid. The methods considered include the inclined tube, the zero-method, and float methods which employ either a microscope or an optical system to magnify the displacement. The instruments described include the Prandtl vertical tube manometer, the Reichardt torsion balance, and syphon and bell-jar weighing devices. Mention is also made of the U-tube methods available for the measurement of pressure differences. R. W. P.

*2941. **Compensation of Strain Gauges for Vibration and Impact. W. M. Bleakney.** *Bureau of Standards, J. of Research,* 18. *pp.* 723–729, *June*, 1937.—In general a strain gauge, when attached to a vibrating member, undergoes deformations on account of the inertia of its parts, and these may cause serious errors in the strain readings. It has been customary in the past to decrease the mass and increase the rigidity of the gauge in an effort to minimise these deformations and correct for the small resulting error. It is, however, frequently not feasible to construct a gauge sufficiently light and rigid to make this possible. This paper describes methods for so adjusting the ratio of inertia to rigidity of the parts of the gauge that these deformations are compensating. The indication of the instrument may thus be made independent of any acceleration of the gauge as a whole. AUTHOR.

See also Abstract 2958.

GRAVITATION.

2942. Gravity Anomalies. E. A. Ansel. *Beitr. z. angew. Gephys.* 7. 1. *pp.* 21–38, 1937.—Analysis of gravity anomalies does not indicate that the downwarp of the Gangetic Trough extends beyond the first and second layers of the crust. W. A. R.

See also Abstracts 2957, 2970.

HYDRODYNAMICS AND AERODYNAMICS.

2943. Two-Dimensional Potential Theory. Part III. Line Source Influence Problems. Rosa M. Morris. *Phil. Mag.* 23. *pp.* 1082–1096, *June*, 1937.—The influence of a line source outside and parallel to the generators of a cylinder is discussed by the method of conformal transformation. Electrical and hydrogenamical cases relating to circular, elliptic, and general types of cylinders, and to cylinders in a stream due to a line vortex are discussed, and it is shown how complete results for all cases, including those discussed by Bateman, by Wrinch, and by Bickley, can be deduced by the consistent use throughout of the complex potential. [For Part II see Abstract 1941 (1937).] J. S. G. T.

2944. Waves of Water of Finite Depth Due to Disturbance Beneath the Surface. Y. Nomura. *Tohoku Univ., Sci. Reports*, 25. *pp.* 1070–1109, *March*, 1937. *In English.*—In this paper are treated some problems of waves of water of finite depth caused by a disturbance beneath the surface. Some cases of variation of the source with the time are considered. The surface elevation is given by the superposition of component waves due to direct pulses and to pulses reflected at the bottom and each component elevation is separately interpreted. AUTHOR.

2945. Velocity Distribution near Walls. A. Izakson. *Techn. Phys., U.S.S.R.* 4. 2. *pp.* 155–162, 1937. *In English.*—In turbulent flow along a smooth pipe or channel, let U be the mean velocity, U_m the velocity in the middle, a the radius of the pipe or half-width of the channel, y distance from the wall, τ_0 the intensity of skin-friction, ν the kinematic viscosity, and $V_* = \sqrt{(t_0/\rho)}$. The author shows that the logarithmic formula for U near a wall follows simply from the assumptions that U/V_* is a function of $V_* \, y/\nu$ only in the neighbourhood of the wall, $(U_m - U)/V_*$ is a function of y/a only, and U_m/V_* a function of $V_* \, a/\nu$ only, without any further assumptions as to the mechanism of the turbulence. Certain relations concerning the laminar sub-layer are then discussed, on the assumption that, if $a\delta$ is its thickness, and $U(\delta)$ the velocity at its boundary, $\tau_0 = \beta \, \mu \, U(\delta)/a\delta$, where μ is the viscosity and β a universal constant. S. G.

2946. Oscillations of a Sphere Filled with a Viscous Liquid. N. A. Slioskin. *Comptes Rendus (Doklady) de l'Accad. des Sciences, U.S.S.R.* 14. 6. *pp.* 333–336, 1937. *In French.*—The following problem is discussed mathematically: a sphere filled with viscous liquid rotates about an axis under the action of a couple $N(t, \phi, \Omega)$ given by $C + A\cos mt - a\,\phi - \beta\,\Omega$, where A, C, a and β are constants, in the frequency of the perturbing force, ϕ the angular rotation, and Ω the angular velocity of the sphere; determine the motion of the sphere. The analysis employs the method due to Riemann. J. S. G. T.

2947. Hydrodynamical Boundary Problem. A. Pleijel. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A*. *No.* 17. [9 *pp.*]. 1937. *In German.*—A method is given for the calculation of the velocity of viscous incompressible fluid inside a sphere according to the linearised equations for unsteady motion (quadratic inertia terms neglected), the initial velocity inside the sphere being zero, and the velocity on the sphere being a given function of position and time. The solution is obtained by a new method of using series of sperhical harmonics. A similar method may be used for the space outside a sphere. S. G.

2948. Calibration of Vane Current-Meters in Still Water. R. Bourgeat, D. Cahuzac and J. Deuillin. *Comptes Rendus,* **204.** *pp.* 1164–1166, *April* 19, 1937.—The relation between the velocity of displacement V of a vane current-meter, and the registration, n, of the revolutions of the vane per unit time, when the meter is transported in a channel of depth H, is, for a large range of velocities, given by $V = a + bn$, where a and b are constants. For a certain range however, the relation between V and n is better represented by $V - bn = a + e$, where e is a variable quantity which becomes noticeable at a velocity c, a little less than the velocity of propagation of waves in the channel, and attains its maximum value when $V = c$ and then vanishes for a value of V a little greater than c. The significance of this result in interpreting results obtained by Epper, is discussed. The effect of obliquity of the helix of the vanes to the direction of translation of the meter is briefly referred to. **Erratum,** *ibid.* p. 1965, June 28, 1937. J. S. G. T.

2949. Efflux of Air at Supersonic Velocities Through Small Orifices. L. Agostini. *Comptes Rendus,* **204.** *pp.* 1311–1313, *May* 3, 1937.—The efflux of air through orifices, of 0·03—0·5 mm. dia., at supersonic velocities in air has been investigated experimentally. The incidence of a supersonic velocity of efflux is demonstrated by the occurrence of striae in the discharge ; these are made visible by a method due to Parenty. Emden's relation $\lambda = 0{\cdot}87d\ \sqrt{(P/p) - 1{\cdot}89}$, for the wave-length λ of the striae in terms of the pressures, P and p, upstream and downstream respectively, is verified for all diameters, d, used. At pressures near the theoretical critical value, the characteristic striae disappear at the following respective values of P/p : $d = 0{\cdot}06$ mm., $P/p = 2{\cdot}20$; $d = 0{\cdot}1$ mm., $P/p = 2{\cdot}10$; $d = 0{\cdot}2 - 0{\cdot}5$ mm., $P/p = 1{\cdot}95$. Emden's relation holds so long as the striae are present. The issuing jet appears therefore to pass suddenly from the supersonic to the subsonic *régimé.* J. S. G. T.

2950. Venturi Tubes and the Supersonic Flow of Fluids. J. Chalom. *Comptes Rendus,* **204.** *pp.* 1614–1615, *May* 31, 1937.—The efflux of fluid through an orifice at velocities exceeding that of sound and the entrainment of fluid by the jet issuing into a Venturi tube of either the convergent-divergent or divergent-convergent type is investigated by an interferometer method. Values of the jet-reaction produced in both kinds of tubes are tabulated for efflux pressures ranging from 1 to 4 kg./cm.^{2} Maximum values of this reaction occur at pressures of 1·5 and 3 kg./cm.^{2} in the case of each tube. J. S. G. T.

See also Abstracts 2940, 3166, 3265.

KINETIC THEORY OF MATTER.

See Abstracts 2928, 2931, 3192.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***2951. Calibration of Weights. F. H. Hurley, Jr.** *Indust. & Engin. Chem.* (*Analytical Edition*), 9. *pp.* 239–243, *May* 15, 1937.—A complete and rigorous explanation of Richards' method for the calibration of weights [see Abstract 1769 (1900)] is presented, and the approximations involved are pointed out. The calculation of " preliminary values " in the usual manner is shown to be an illogical procedure which has led to confusion regarding the theory of the method, though it is ordinarily without serious effect on the results obtained. An analysis of the observational errors in the calibration process is made and the effect of the individual errors on the separate weight corrections is determined. AUTHOR.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

2952. Significant Figures of Least Squares and Correlations. W. E. Deming. *Science,* 85. *pp.* 451–454, *May* 7, 1937.—A method of obtaining the Doolittle solution associated with the determinant related to a given set of normal equations is illustrated, particular attention being paid to the number of significant figures retained at the various stages of the analysis, and apparent " instability " of the constants occurring in the equations. The deduction of the three parameters defining a curve passing through three points, two of which are close together, is similarly discussed with reference to " bands of significance " of the parameters in order that the three equations in terms of the parameters may be satisfied to the full number of significant figures. A test for stability of the constants of the normal equations is afforded by a comparison between the direct solution and the reciprocal solution obtained by using the reciprocal matrix as a multiplier. J. S. G. T.

2953. Law of Size Distribution and Statistical Description of Particulate Materials. P. S. Roller. *Frank. Inst., J.* 223. *pp.* 609–633, *May,* 1937.—A law of size distribution has been discovered which relates the weight per cent, and from this the frequency, to size of particle. This law satisfies the boundary conditions and the functional form of experimentally observed distributions. Only two constants are involved which are easily determined on the basis of a linear functional relationship. It appears that the grinding together of two or more substances can result in a powder that obeys the normal law of distribution ; this is attributed to the substances partaking of the same equilibrium. The distribution law has been found to hold for materials that have been ground mechanically or reduced by physical or chemical means. The substances that have been tested include ceramic powders, cements, paint pigments, hydrated limes, soils, kaolins and clays. The closeness of fit has been tested and found to correspond to the probable precision of the measurements. The following important physical constants of a powder can be determined in terms of the two distribution constants : the surface area per gram, the number of particles per gram, and the coefficient of uniformity. H. H. Ho.

2954. Direct and Inverse Methods in Statistics. H. Jeffreys. *Roy. Soc., Proc.* 160*A*. *pp.* 325–348, *June* 1, 1937.—The probability distribution of functions of the observed values, given the true value and the standard error, is not obviously the same as that of functions of the true value and standard error given the observations. Direct statistical methods appear to depend for their validity on identifying these two distributions. It is shown here that, in a case discussed as a direct problem by " Student " (*Biometrika,* 6, 1908) and as an inverse one by the present author, the application of "Student's " result for estimation involves an unstated assumption, which is equivalent to the condition that the true value and standard error are initially unknown, and that if this assumption is valid it is completely equivalent to the author's assessment of the prior probability to express this condition. The foundations of classical statistical mechanics are discussed with reference to the probability that a system will approach a steady state. Some defects in the current treatments of the problems are pointed out, and an alternative discussion is given. AUTHOR.

***2955. Accuracy of Planimeters. H. Baer.** *Zeits. f. Instrumentenk.* 57. *pp.* 177–189, *May,* 1937.—The uniformity of rotation of the roller when its axis is at varying angles with the direction of travel was studied in connection with the differences obtained between left- and right-handed circuits. The effects of various arrangements of the roller, of grooving on the roller, and also of wear of the tracing point, which produces an axial obliquity on an old planimeter, are dealt with. Various types of paper were used in the investigation. The error of a planimeter is proportional to the square-root of the perimeter of the measured surface. P. H. B.

***2956. Accuracy of the Mader-Ott Harmonic Analyser. H. Baer.** *Zeits. f. Instrumentenk.* 57. *pp.* 225–235, *June,* 1937.—Three possible sources of error are considered. A nomogram is used to estimate the error caused by a displacement of the curve in the direction of the X-axis. In order to employ the usual linear control with a planimeter and with an analyser the Fourier coefficients of a semicircle are calculated with the help of Bessel functions. In investigating analysers with such linear control the magnitude of the error is shown to be mostly below 0·1 mm. The accuracy with which the S- and C- perforations in the toothed wheels are constructed is found sufficiently. The circumferential error is a rough approximation only of the personal error and is dependent on the rate of rolling. For the determination of multiple coefficients of the same curve a circumferential form is recommended. R. S. R.

***2957. Mathematical Integrators. E. Liustich.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 1. *pp.* 9–11, 1937. *In English.*—Suggests three forms of integrators for the mechanical calculation of integrals of the type $\int \sin(m\theta + \alpha)\sin(n\phi + \beta)\ d\phi$. The simplest form is suggested for calculating the solid angle ω at which the surface enclosed by the contour S is seen from the origin. Such an integrator is of use in magnetometry and gravimetry (calculation of magnetic potential and of vertical component of the force of gravity). A more complicated form of the integrator serves to calculate the expression $\int \cos 2\theta \cdot d\phi$. Such a system would be useful in photometrical calculations, since the illumination at a point on a plane produced by a parallel plane luminous surface of uniform light intensity B is expressed by the integral over the contour of the luminous surface $B/4 \int (1 - \cos 2\theta) d\phi$, the origin being the illuminated point. A third form of integrator serves for determining integrals of the type $\int \cos m\theta \cdot \sin n\phi \cdot d\phi$. Such integrators may be applied to problems in gravimetry, since the variations of g measured by the gravitational variometer are expressed, for a plane horizontal layer, by formulæ of this type. J. S. C.

See also Abstracts 2899, 2938, 2939, 2943, 3284.

MECHANICS, CLASSICAL.

2958. Problems of Frictional Vibration. S. Higuchi. *Tohoku Univ., Sci. Reports,* 25. *pp.* 1121–1135, *March,* 1937. *In English.*—In this paper, the problems of the oscillatory motion of a system consisting of an elastic rod or spring and its attached load in which the usual type of solid friction as well as the elastic force are called into action are solved by using either the method of complex integration or that deduced from Green's theorem, according to the nature of the individual problem. From the result obtained here, the main characteristic properties of the motion in question, such as the decrease of the damping ratio or the logarithmic decrement, are fully discussed. AUTHOR.

See also Abstract 2954.

MECHANICS, QUANTUM.

2959. Geometry in Spin-Space. T. Sibata. *Hiroshima Journ. Sci.* 7. *pp.* 151–168, *March*, 1937. *In English.*—Morinaga's wave geometry involves an expression $ds\psi$ for the metric in general microscopic space containing a function ψ which is a 1–4 matrix given as a solution of the "unknown Dirac equation." In the author's projective wave geometry [see Abstract 2557 (1936)] ψ again appears as a 1–4 matrix. In this paper it is shown that the same results as those given in the wave geometry can be obtained on the basis of the connections in the spin side, taking space admitting a spin-collineation, instead of considering $ds\psi$, and hence is obtained the unknown Dirac equation, the fundamental equation for ψ. The conditions of integrability are deduced and classified. The problem is first treated as a four- and then as a five-dimensional case. As an application of the latter part the results in the projective wave geometry are re-examined and another form of wave geometry based on the Einstein-Mayer geometry is established. N. M. B.

2960. General Parallel Displacement which Makes $ds\psi = 0$ Invariant. K. Morinaga. *Hiroshima Journ. Sci.* 7. *pp.* 169–172, *March*, 1937. *In English.*—The most general parallel displacement which makes $ds\psi = 0$ invariant is found and analysed, first for the four- and then for the five-dimensional case; in each case it can be reduced to a parallel displacement in the vector space. [See following Abstract.] N. M. B.

2961. Geometrical Interpretations of Wave Geometry. K. Morinaga. *Hiroshima Journ. Sci.* 7. *pp.* 173–177, *March*, 1937. *In English.*—Interpretations when the parallel displacement can be reduced to that of the vector space only [see preceding Abstract] are considered for the four- and five-dimensional cases under various conditions. [See also Abstract 1534 (1937)]. N. M. B.

2962. Symmetry of the Transmission Coefficients for the Passage of Particles through Potential Barriers. M. Muskat and E. Hutchisson. *Nat. Acad. Sci., Proc.* 23. *pp.* 197–201, *April*, 1937.—A general wave-mechanical proof is given of the assumption that the transmission coefficient of electrons through potential barriers is independent of the direction of motion of the incident electron. N. M. B.

2963. Interaction of Two Particles in Relativistic Wave Mechanics. J. L. Destouches. *Comptes Rendus*, 204. *pp.* 1403–1406, *May* 10, 1937.—The author extends his theory of relativistic wave mechanics of a system of particles [see Abstract 1963 (1937)] by deducing an expression, satisfying the conditions of this theory, for an operator giving the interaction of two Dirac particles. The operator found is not in accord with Coulomb's law, indicating that the interaction of two electrons cannot be treated relativistically as a two-particle problem, but that appeal must be made to Dirac's hypothesis that the Coulomb forces are due to the interactions between photons or neutrinos and each of the electrons. The operator found satisfactorily covers, however, the case of a system of electrons or positrons and neutrinos or antineutrinos. N. M. B.

2964. Newton's Problem in Wave Mechanics. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 18. [12 *pp.*] 1937. *In French.*—On the basis of Schrödinger's equation a wave mechanical solution is deduced for the following problem originally solved by Newton by classical mechanics: the attraction or repulsion between two particles varies inversely as the square of their distance of separation, if their positions and velocities are known at a certain instant t^0 to calculate their positions and velocities at a subsequent instant t ($t > t^0$). In wave mechanics the latter part of the problem takes the form, if the wave function which gives the probability of the positions and velocities at t^0 is known, to calculate this function for t. N. M. B.

2965. Interpretation of Dirac Operators by Means of Fundamental Hyperspace Magnitudes. J. Roubaud-Valette. *Comptes Rendus,* 204. *pp.* 1406–1408, *May* 10, 1937.—Dirac's operators are treated as complex numbers instead of as matrices, and, using a system previously applied to a study of the photon equations [see Abstract 2085 (1937)], a series of correspondences is deduced between the Dirac operators and the hyperspace magnitudes. N. M. B.

2966. Generalisation of Dirac's Relativistic Wave-Equation. O. Klein. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 15. [19 *pp.*], 1937. *In German.*—A generalisation of the Dirac equations for the electron is worked out with the object of obtaining equations applicable to particles of any mass, in particular, to protons. The equation of continuity is deduced and the value of the magnetic moment of a particle calculated. G. C. McV.

2967. Dirac's Theory of the Electron. Part II. M. Markow. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 284–296, 1937. *In German.*—The equation of second order for a particle with spin which was suggested by the author [see Abstract 1956 (1937)] is treated by a method which Pauli and Weisskopf used for the discussion of the equation for a particle without spin. The resulting equations contain states of positive as well as of negative energy and are therefore useless. R. P.

2968. Generalisation of the Equations of the Self-Consistent Field for Two-Electron Configurations. A. F. Stevenson. *Roy. Soc., Proc.* 160*A. pp.* 588–604, *June* 15, 1937.—The form of the wave function assumed in the ordinary method of the self-consistent field is generalised so as to allow for the correct spatial symmetry corresponding to a given term arising from a given configuration of the two valence electrons, and, in addition, an adjustable function of the angle between the two radii vectores is inserted as a multiplying factor. Application of the variational method then yields differential equations for the radial functions which are similar to those of the ordinary theory, together with an equation for the angular function. The equations are also given for the case when exchange degeneracy is taken into account. The equations with exchange prove to be quite complicated, but those without exchange should be soluble without too much labour when the corresponding solutions of the ordinary self-consistent field equations are available. The application of the method when the core electrons are taken into account in the assumed form of the wave function is also briefly considered. AUTHOR.

2969. Potential Function of H_2O. G. W. King. *J. Chem. Phys.* 5. *pp.* 405–415, *June,* 1937.—The energy of a molecule is expressed by a complete quadratic form, for use with frequencies corrected for anharmonicity. Reduction of the force constants in Cartesian coordinates to an independent set by relations due to symmetry and mutual forces is carried out by a systematic matrix method which is particularly useful in correcting for anharmonicity and for finding functions of the frequencies and masses invariant in isotopic molecules. For H_2O and D_2O these relations being satisfied, the potential function is indeed assumed to be unchanged, all constants are computed, and compared with those of various models. In the S — P picture of the H_2O molecule the H — H repulsion, ionic terms in OH bonding and exchange integrals in the angular function prove to be the values expected theoretically. The vibrational energy levels of a polyatomic molecule with quartic terms in the potential function are determined by matrix mechanics, and the change on substitution of an isotope formulated. Applied to H_2O and D_2O, frequencies at the zero point are obtained that satisfy invariants calculated for harmonic motion.

AUTHOR.

See also Abstracts **2872**, **2892**, **3038**, **3051**.

RELATIVITY AND ETHER.

2970. Gravitational Field of a Distribution of Particles Rotating About an Axis of Symmetry. W. J. v. Stockum. *Roy. Soc. Edinburgh, Proc.* 57. 2. *pp.* 135–154, 1937.—Einstein's gravitational equations are solved for the field in the interior of an axially symmetric distribution of particles rotating with constant angular velocity about the axis of symmetry. A geometrical definition of axial symmetry is used in terms of the coordinates of a certain privileged observer whose world-line is a geodesic. The field inside an infinite rotating cylinder is also obtained and the associated external field calculated. It appears that there are two different types of external field according as the radius of the cylinder does or does not exceed a certain critical value. G. C. McV.

2971. Graphical Illustration of the Michelson-Morley Experiment. H. E. Ives. *J.O.S.A.* 27. *pp.* 177–180, *May,* 1937.—A graphical interpretation of the Michelson-Morley experiment is given. By this means the Fitzgerald-Lorentz contraction is discussed in relation to the Michelson-Morley experiment and that of Kennedy and Thorndyke with unequal interferometer arms. A possible clock rate exists which, for any length contractions in the direction of motion and at right angles to it in the ratio $(1 - v^2/c^2)^{\frac{1}{2}} : 1$, will explain the null results, and experiments of this type cannot alone prove the Larmor-Lorentz hypothesis. A Fitzgerald-Lorentz contraction equalises the light path in the two arms, but the rays still enter or leave the apparatus at the aberration angle to the axis and hence the stationary and moving systems are not identical.

H. G. C.

See also Abstracts **2959**, **2960**, **2961**, **2963**.

SOLUTION.

2972. Solubility of Inorganic Substances in Liquid SO_2. G. Jander and W. Ruppolt. *Zeits. f. phys. Chem.* 179. *Abt.A.* 1. *pp.* 43–50, 1937.—The author briefly deals with the chemistry of solutions in liquid SO_2 before describing the method adopted for determining the solubilities at 0° C. of 80 or 90 substances, mostly inorganic. The substances were dissolved in the liquid at one end of a closed glass tube containing at its centre a glass-wool filter. Excess solid was filtered from the saturated solution by inverting the tube, and the lower end of the tube was then drawn off. The solutions were added to water and the desired solubilities were calculated from the composition of the resulting liquids as determined by chemical analysis. The results are discussed. Those substances having a high solubility appear to be those which form definite solvates. The solutions are dissociated. P. H. B.

See also Abstracts 2927, 3174.

SURFACE TENSION AND COHESION.

2973. Growth of Interfacial Tension in the Region of Saturation. F. Barillet and (Miss) A. Choisnard. *Comptes Rendus*, 204. *pp.* 1418–1419, *May* 10, 1937.—Reasons are given for supposing that the interfacial tension between a solid and its solution rises as saturation is approached and passed. P. H. B.

2974. Theory of Surface Tension of Aqueous Solutions of Dipolar Ions. K. Ariyama. *J. Chem. Phys.* 5. *pp.* 467–469, *June*, 1937.—A theory of surface tension of solutions of the dipolar ions is proposed. The theory is based on the idea of "image force" at the boundary of air and water. The experimental facts are satisfactorily accounted for by the theory. AUTHOR.

2975. Surface Tension of Colloidal Substances. S. N. Banerji. *Indian Acad. Sci., Proc.* 6. *pp.* 317–320, *Nov.*, 1936.—The surface tension of some naturally occurring lyophilic colloids and heavily hydrated inorganic colloids has been determined by a modified form of Traube's apparatus. The results prove that high hydration of colloid particles does not affect the surface tension of the dispersing medium appreciably and the dissolved substance present in the true molecular state is responsible for the change in surface tension. The effects of electrolytes on the surface tension of these sols have been also casually studied. AUTHOR.

2976. Effect of Uni-Univalent Electrolytes upon the Interfacial Tension between Normal-Hexane and Water. A. W. Evans. *Faraday Soc., Trans.* 33. *pp.* 794–800, *June*, 1937.—Experimental results are given showing the effect of the alkali metal chlorides, of KNO_3, of KCNS, and of NaOH on the interfacial tension between *n*-hexane and water at 25·0° C. Comparison of the results for the alkali metal chlorides with the corresponding surface tension results, supports the Onsager-Samaras theory as opposed to the theories of Ariyama and Oka. The effect of the existence of the electric double layer at the interface on the theoretical treatment of Onsager and Samaras is discussed, and a suggested explanation of the discrepancy between the theory and the experimental results is given. AUTHOR.

2977. Homologous Series. J. H. C. Merckel. *Kolloid-Beihefte*, 45. 11–12. *pp.* 413–470, 1937.—Relations between the number n of C atoms per molecule in the members of various homologous series and (*i*) surface tension, (*ii*) adsorption, and (*iii*) viscosity, are dealt with in some detail. (*i*) Following a discussion of Traube's rule and Szyskowski's law it is shown that for dilute solutions of fatty acids, acetates, propionates, alcohols and dicarboxylic acids, $\log \tan \alpha = an + b$ where α = angle made by the surface tension concentration (c) curve with the negative direction of the c axis, a is a constant for all these series, and b varies from series to series. The physical meaning of this law is discussed, and it forms the basis of the discussion of various methods of determining surface tension. For a given series, the surface tensions of solutions of strength $> 0{\cdot}25$ *N* are proportional to "capillary active numbers" (K) which form an arithmetic series of the second order. The different behaviour of dilute and concentrated solutions is explained on the supposition that in dilute solutions the molecules are oriented parallel and in concentrated solutions perpendicular to the surface. (*ii*) Some of Freundlich's adsorption results and some new data for the adsorption of fatty acids on potato starch are discussed in relation to the values of K. (*iii*) Linear relations between *n* and the viscosities of solutions of given strength of (*a*) Na salts of higher fatty acids, (*b*) Na salts of dicarboxylic acids, and (*c*) lower alcohols, are established and discussed. P. H. B.

2978. Viscosity of Monomolecular Superficial Layers. D. G. Dervichian and M. Joly. *Comptes Rendus*, 204. *pp.* 1318–1320, *May* 3, 1937.—Two monomolecular films of different concentrat;ons and superficial pressures are connected by a channel of which the width, D, and length, L, can be varied. The rate of flow, Q, from that at greater pressure, P, to that at less, *p*, varies directly as P-*p* and inversely as L. The reduced pressure $Q_r = QL/P$ increases with D more than linearly, *e.g.*, with D = 0·66, 4 and 13·3 mm. Q_r for oleic acid on 0·01–*N* HCl is 0·095, 3·7 and 22 respectively. This indicates internal friction (viscosity) in the layer —flowing, and friction between that layer and the supporting water. **Errata,** *ibid. p.* 1516, *May* 19, 1937. C. A. S.

2979. Surface Layer of Polished Silica and Glass with Further Studies on Optical Contact. (Lord) Rayleigh. *Roy. Soc., Proc.* 160*A*. *pp.* 507–526, *June* 15, 1937.—The reflecting power of a polished silica surface examined in a liquid having the same refractive index as the body of the material varies widely according to the treatment. Surfaces polished by a process which removes material rapidly, or surfaces washed in dilute HF, do not reflect appreciably in the liquid. Surfaces polished by methods which do not quickly remove the material may reflect (in the liquid) as much as 0·28 % of the incident light. A kind of burnishing seems to take place which modifies the surface, and may bring up its refractive index from 1·461, the ordinary value, to as much as 1·6, quite as high as light flint glass, and much higher than any known variety of silica. These effects are found in a less degree in ordinary glass, and in a very much less degree in crystal quartz. In normal cases the reflected light changes in tint from red to blue as the refractive index of the immersion fluid is increased through the critical value for minimum reflection. The modified silica surface is anomalous in this respect, the reflection being red on either side of the minimum value. An explanation is suggested for this. The thickness of the modified layer was measured as $0{\cdot}06\lambda$, when λ is the wavelength of green light in air. The variable reflecting power formerly found from the interface of two silica or glass surfaces in optical contact is now explained. It can be controlled by using the present results. Contacted surfaces of crystal quartz give a reflection which is practically independent of the way in which the surfaces have been polished. The mean distance between the two crystals is found to be about 7 times the spacing of the layers of Si atoms within the crystals. [See also Abstracts 4694 (1936) and 1967 (1937).] AUTHOR.

2980. Orientation in Films of Long-Chain Esters. A. E. Alexander and J. H. Schulman. *Roy. Soc., Proc.* 161*A*. *pp.* 115–127, *July* 1, 1937.—Long-chain esters when spread in films on normal caustic soda solutions show remarkable differences in the rate of hydrolysis according to the orientation of the component parts of the molecule. Differences in velocity of some thirty times can be obtained by simple orientation, such that films of esters can be placed on strongly alkaline solutions with only extremely slow hydrolysis taking place. It is shown that this strong inhibition of the hydrolysis is due to the protective sheath of short hydrocarbon chains when in a position beneath the polar group. The state of the film, whether condensed or expanded, is not an important factor in the rate of hydrolysis. The work of compression of the short chain to a position beneath the surface increases by approximately a constant amount for each $-CH_2$ group added; in agreement with the work of Langmuir (1917) on the soluble straight-chain compounds. The observed vertical components of the apparent dipole moment (μ) in the various configurations can be calculated in an approximately quantitative manner using the ordinary law of vectorial summation by assigning a definite electric moment to each component of the polar group. The polar aqueous substrate so reduces the interaction between the constituent dipoles of the ester group that free rotation about single bonds becomes possible, whereas in non-polar solvents the rotation is restricted. AUTHORS.

2981. Theory of Electrocapillarity. Part VI. Electrophoresis. S. R. Craxford, O. Gatty and H. A. C. McKay. *Phil. Mag.* 23. *pp.* 1079–1082, *June*, 1937.—Electrophoresis in the case when the interphase between the two phases is completely polarisable and the potential gradient causing electrophoresis is vanishingly small is discussed briefly. The case of a drop of Hg electrophoresing in a solution containing no ions is considered, and it is shown, by consideration of an isothermal cycle, that the electrophoretic force on a particle is $Q\Delta V/\Delta x$ where Q and $\Delta V/\Delta x$ have their customary significance. It follows (1) that the electrophoretic and the electrolytic null points are the same; (2) that the electrophoretic force on a symmetrical particle is proportional to the difference of surface tension at its ends; (3) that electrophoresis at vanishingly small potential gradients cannot arise from a double layer of specifically adsorbed salt or from any other type of double layer situated entirely on one side of the impenetrable boundary of the interphase, and (4) that $F = sC(\phi - \phi_{null})\Delta V/\Delta x$, where s is the surface area of the particle, C the capacity per unit area of the double layer, and ϕ, ϕ_{null} have their usual significance. [See Abstracts 4040 and 4041 (1936).] J. S. G. T.

2982. X-Ray Determinations of Volumes of Mercury Menisci. W. H. Keesom, (Miss) H. van der Horst and K. W. Taconis. *K. Onnes. Lab., Leiden, Comm. No.* 248*a*. *Physica*, 4. *pp.* 494–498, *June*, 1937. *In English.*—Determinations of the volumes of mercury menisci were made by means of X-ray shadowgraphs; the tubes having radii of 3·965, 5·700, 7·845 and 9·422 mm. respectively. AUTHORS.

2983. Kinetics of Wetting and Linear Corrosion of Metals in Polyphase Systems. Part II. D. I. Mirlis. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 9. *pp.* 549–552, 1937. *In English.*—It is shown by experimental methods similar to those previously used [see Abstract 5025 (1936)] that the corrosion of Fe, Cu and other metals in polyphase contact with liquids (metal-liquid-liquid and metal-liquid-gas) is linear. By studying the variation of contact angle with time it is ascertained that the corrosion, particularly of iron, in the above systems exhibits selective localisation mainly along the phase boundary line in accordance with Kistiakovski's ideas and not in the centre as might be expected on the basis of the differential aeration theory. Doubt is thrown on the importance of the differential aeration factor in corrosion in this system. The molecular changes undergone by a metal surface in equilibrium systems metal-liquid-gas may be followed quantitatively by measuring the contact angle of wetting. P. H. B.

2984. Water Content of Porous Materials. R. J. Schaffer, J. Wallace, and F. Garwood. *Faraday Soc., Trans.* 33. *pp.* 723–734, *June*, 1937.—Centrifuge experiments were carried out on Portland stone initially saturated with water. The observed moisture gradient along the radial length of the sample is explained on the basis $h = A(\omega) - \omega^2 r^2/2g$ where h is the head of water equivalent to the pressure deficiency at a point distant r from the axis of rotation and $A(\omega)$ is a constant for angular velocity ω and any one position of the specimen. Distribution experiments show that $A(\omega) = \omega^2 c^2/2g$ where c is a constant independent of ω. Experimentally determined values of c lead to $h = \omega^2(a^2 - r^2)/2g$ where a is the distance of the outermost parts of the centrifuged specimen from the axis, which indicates that if the outer surface is a cylinder coaxial with the centrifuge, this surface is saturated. This is a result often assumed on the basis of inadequate evidence. A comparison is made between curves relating pressure deficiency with water content as determined by the hydrostatic and centrifuge methods. P. H. B.

2985. Spreading of Liquids in Filter-Paper. Part I. K. Prosad and B. N. Ghosh. *Kolloid Zeits.* 79. *pp.* 19–29, *April*, 1937.—The spreading of 21 liquids was investigated; a liquid droplet spreads in the form of an ellipse and the rate of growth of either axis is shown to be a succession of two exponential functions of the length of axis, a discontinuity occurring when the surface layer of liquid is wholly absorbed into the paper. Methods are given for estimating the void-content and fibre-density of the paper. Constants determined from the spreading equations are a regular function of chain length in homologous series but side-chains require separate treatment. L. V. C.

See also Abstracts 2871, 3243.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***2986. Performance of Shortt Clock at Stockholm Observatory. J. M. Ramberg.** *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A*. *No.* 20. [11 *pp.*], 1937. *In English.*—Gives details of installation and performance of Shortt clock No. 46 in a specially prepared room in the basement of the main building of the Observatory at Stockholm. The performance over the period Dec. 1933 to Aug. 1935 is reported in detail, and it is stated that the secular acceleration of the pendulum proved negligible during this period—a result which does not confirm the opinion of Pavel and Uhink, who found evidence of disturbances of the earth's rotation during part of this period. J. S. C.

***2987. Watch Rate Recorder.** *Engineer,* 163. *p.* 576, *May* 14, 1937.—Describes a watch rate recorder consisting of two units, so coupled that the beat or "tick" of the watch under test can be compared with a.c. of known frequency. The beat of the watch operates a microphone, the output of the latter being amplified to actuate a stylus which makes a record on a drum of graph paper. The drum is rotated at exactly 300 r.p.m. by a synchronous motor, the frequency of which is controlled by a 300-cycle tuning fork. J. S. C.

***2988. Time Determination and Time Broadcast. J. F. Hellweg.** *Frank. Inst., J.* 223. *pp.* 549–563, *May,* 1937.—Gives a history of broad-casting of time by telegraphy and radio, and a brief description of the determination of time by means of the photographic zenith tube, and concludes with a description of the U.S. Naval Department's present automatic time broadcaster, which includes a crystal-controlled oscillator, a synchronous motor with field coils which can be rotated for correction of time errors, a chronograph and an automatic broadcaster. J. S. C.

See also Abstract 2997.

VISCOSITY, FRICTION AND LUBRICATION.

***2989. Simple Method for Measuring Coefficient of Non-Viscous Friction of Thin Lubricating Layers. S. Kyropoulos and E. I. Shobert.** *Rev. Sci. Instruments*, 8. *pp.* 151–158, *May*, 1937.—A pendulum-type machine where the suspension on which the lubricant is tested consists of a ground and polished journal, free to oscillate on four fixed steel balls, is fully described. From the equation of oscillation of the pendulum an approximate formula is deduced giving the coefficient of non-viscous friction in terms of amplitude measurement and the fundamental constants of the apparatus. A more accurate analysis ahows that the simple method is sufficient for comparative work. When the friction is purely non-viscous the amplitudes plotted against period-number fall on a straight line, whilst if viscous friction is present a curve is obtained. Full operating details are given and further possible uses of the instrument, such as the measurement of film strength, are outlined. A. G. Q.

2990. Internal Friction in Solid Dielectrics. A. Gemant and W. Jackson. *Phil. Mag.* 23. *pp.* 960–983, *May*, 1937.—The methods of free torsional and free lateral vibrations have been employed to study the internal damping of several solid dielectric materials—ebonite, trolitul, quartz, glass and wood—over the frequency range 0·3 to 10 ∼. The classical assumption that the friction is of a viscous character is found to be an erroneous one. The " viscosity constant " of this classic analysis is found to vary inversely as the frequency to a first approximation. This corresponds to a constant energy loss per cycle. This behaviour is in agreement with certain observations of A. C. Kimball, and is probably to be explained in terms of solid friction. An alternative explanation based on the conception of a complex viscosity is also considered. The dependence of the elasticity modulus and the damping on temperature has been studied between 20 and 180° C. The general tendency is for the former quantity to decrease and the latter to increase with temperature, although the damping-temperature curve for two glass samples exhibits a low-temperature maximum preceding this normal behaviour. AUTHOR.

2991. Physical Properties of Surfaces. Part IV. Polishing, Surface Flow and Formation of Beilby Layer. F. P. Bowden and T. P. Hughes. *Roy. Soc., Proc.* 160*A*. *pp.* 575–587, *June* 15, 1937.—The process of polishing is greatly influenced by the relative melting-point of the polisher and the solid. The relative hardness is comparatively unimportant. Experiment suggests that surface flow is brought about by an intense local heating of the surface irregularities to the melting or softening point. The molten or softened solid flows or is smeared over the surface, and very quickly solidifies to form the polished Beilby layer. These local high temperatures also play an important part in the wear and corrosion of sliding surfaces. [For Part III see Abstract 2294 (1936)]. AUTHORS.

See also Abstracts 2958, 2977, 2978, 2985, 3181, 3224, 3225.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2992. Objective of Large Strasbourg Refractor. A Couder.** *Rev. d'Optique*, 16. *pp.* 1–22, *Jan.*, 1937.—This compound lens, made in 1880, is of 7 m. focal length and 48·6 cm. aperture. The paper describes its re-working at the Observatory of Paris in 1933. The properties of the Littrow combination are discussed: its overwhelming disadvantage is that it does not obey the sine condition. In order to remove the resulting coma, drastic alterations in the curvature of the surfaces of at least one component would have been necessary; these were not regarded as justified. The methods used for compensating for axial astigmatism, due mainly to variations of refractive index in the lenses, and for zonal aberrations, due to careless local polishing, are fully described: they involved deforming one surface and repolishing some of the others. Results are given of Hartmann and Foucault tests, and of measurements of chromatic aberration, before and after retouching. The aberrational effect of double refraction due to internal strain in the lens components is similar to that previously described [see Abstract 1030 (1933)]; and a compensator is proposed [see following Abstract]. A. Hu.

***2993. Adjustment of Couder Double-Refraction Compensator. A. Danjon.** *Rev. d'Optique*, 16. *pp.* 23–27, *Jan.*, 1937.—The double refraction due to internal strain in the Strasbourg objective [see preceding Abstract] is neutralised by that due to a plate of spar of suitable thickness, cut with parallel faces perpendicular to the crystallographic axis. The plate is 4·6 mm. thick and 15 mm. across, and is interposed between the objective and the eyepiece, close to the latter. It is enclosed between 2 glass pates, of which the one nearer the objective is worked so as to act as a collecting lens. The axis of the compensator is aligned with that of the objective by systematic trial and error. When the orientation is correct, the fringes produced in a Savart polariscope by light from the sky are not distorted by interposing the compensated objective. The effects produced by incorrect adjustment are illustrated and discussed. Practical measurements of resolving power and of depth of focus obtained before and after the re-working of the objective and the provision of the compensator are compared. A. Hu.

***2994. Zeiss-Toepfer Coelostat of the Berlin-Babelsberg Observatory. H. Schneller.** *Zeits. f. Instrumentenk.* 57. *pp.* 208–211, *May*, 1937.—The coelostat was constructed so that the more sensitive kinds of photoelectric apparatus which are now available, but which need to be kept stationary, could be used for stellar brightness measurements. The main mirror, of 40 cm. dia., in rotating about its polar axis at one-half the earth's rate, throws a beam of the star's light, invariable in direction, on to a 33 cm. auxiliary mirror, which directs it vertically downwards into the telescope objective. A synchronous motor rotates the main mirror, through interchangeable gear-trains, by 180° in either a sidereal or a solar day, as desired. To prevent obscuration of the main mirror by the auxiliary one when observing a star of small declination and small hour-angle, the former is made movable in an E.–W. direction. A. Hu.

***2995. Astronomical Applications of Rotatory Dispersion. Y. Öhman.** *Arkiv f. Mat., Astron. och Fysik, Stockholm,* 25*B. No.* 19 [5 *pp.*], 1937. *In English.*—It is suggested that rotatory dispersion might be used for the photographic determination of colour indices. In front of the photographic plate of a Newtonian reflector are placed 3 plane crystal plates: the first, 4 mm. of Iceland spar, splits the light of each star into 2 polarised beams; the second, 3 mm. of quartz cut perpendicular to its axis, rotates the plane of polarisation to a different degree for different wave-lengths; beyond the third, of Iceland spar turned 90° relative to the first, a final pattern of 2 blue and 2 u.v. images of each star is photographed, if ordinary plates are used. The relative intensity of these images varies with spectral type and provides a measure of u.v. colour index. A tourmaline plate in front of the system may be used to reduce the intensity of one pair of images and thence to determine the plate characteristics. The device may also be used in front of an objective prism spectrograph. In this case it is shown that wave-length standards can be obtained in slitless spectra. The use of objective prisms in radial velocity work would therefore be possible. A. Hu.

See also Abstract 2986.

COMETS AND METEORS.

2996. Disappearance of Biela's Comet. J. Bosler and H. Roure. *Comptes Rendus,* 204. *pp.* 1381–1384, *May* 10, 1937.—A history of the Comet and of the Bielid meteors is given; and the authors adopt a suggestion of C. Bruhns that the disappearance may be due to collisions with the Leonid meteor stream (comet 1866, I.); Bruhns calculated an approach of the two orbits of 0·05. The authors verify this more precisely by taking the anomalies of the two orbits as independent variables and expressing the distance of two points as a function of these, then fixing one anomaly and finding the minimum relative to the other, and so through successive approximations. They establish that on 6th Jan. 1846, at 20 h. 44 m. the distance of Biela's comet from the mean orbit of the swarm was only 0·0138 A.U., and, not only did the orbits nearly cut but it was near the epoch (13th Jan. 1846) when many saw the comet as double. A. S. D. M.

COSMOGONY.

See Abstracts 3006, 3079.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstracts 3005, 3006, 3079.

LATITUDE AND LONGITUDE.

2997. Periodic Variations of Longitude. N. Stoyko. *Comptes Rendus,* 204. *pp.* 1577–1579, *May* 24, 1937.—The comparisons of hourly time signals at observatories show notable changes from one year to another, and these are probably due to the variation of the longitudes themselves, and not either to systematic errors of the reception of the signals, or of the time determinations. Graphs are given of the relative variations, during 17 years, of Greenwich, Leningrad, Paris, Tokyo, and Washington. The author compares the differences of variation of Paris-Tokyo and of Washington-Paris with the solar activity (1927–1936) curve or its inverse; the correlation being of great solar activity with great longitude variation—the maximum activity showing $0^{s}\cdot 016$ to the minimum of $0^{s}\cdot 011$; at maximum the long axis of the ellipse is parallel to the line of 45°, Paris-Tokyo, and at minimum to that between Washington-Paris. A. S. D. M.

NEBULÆ.

2998. Physical Processes in Gaseous Nebulæ. Part I. Absorption and Emission of Radiation. D. H. Menzel. *Astrophys. J.* 85. *pp.* 330–339, *May*, 1937.—In this paper, the first of a series dealing with the physical state of gaeous nebulæ, various fundamental formulæ are derived. The total emission and absorption of radiation by atomic H are evaluated, together with the number of transitions to and from any quantum level, discrete or continuous. The equations are thrown into simple homogeneous form. The general equations that determine the statistical equilibrium of the assembly and the partition of atoms into various atomic states are developed. Solution of these equations is deferred until a later paper. AUTHOR.

2999. Photometry of Andromeda Nebula, M 31. R. O. Redman and E. G. Shirley. *Roy. Astron. Soc., M.N.* 97. *pp.* 416–423, *April*, 1937. —The nebula has been traced to a major axis diameter 267′; minor 89′. The axis ratio, for points of equal surface brightness, varies from near 1 at the centre down to 0·31; in the outermost region measured it is 0·33. Comparison is made with the photoelectric measures of Stebbins and Whitford. The total luminosity is $3^{m}\cdot 6 \pm 0^{m}\cdot 3$ (photographic), while the surface brightness at the centre is at least $14^{m}\cdot 8/(\text{second of arc})^2$. At the centre of M 33 the surface brightness is $20^{m}\cdot 3/(\text{second of arc})^2$. AUTHORS.

3000. New Cluster of Nebulæ in Pisces. F. Zwicky. *Nat. Acad. Sci., Proc.* 23. *pp.* 251–256, *May*, 1937.—Plates, covering about one-fifth of the sky, were taken with the 18in. Schmidt telescope. A new cluster is found in Pisces with large extension (diameters in ratio 1 : 5) and asymmetrical flat shape, suggesting that as a whole it is rotating. The faintest apparent magnitude is $m = 16$, and the total number brighter than this is about 120. In this region the average number per sq. degree is 2·2 nebulæ but in the concentrated region reaches 30 nebulæ per sq. deg. A list is given of the pg. magnitudes of the 18 brightest nebulæ. According to Hubble, the 5th brightest nebula in an average cluster has abs. mag. $M_5 = 16\cdot 4$; in the Pisces concentration the corrected apparent magnitude of the 5th brightest is $m_5 = 13\cdot 1$ giving the distance as $25\cdot 8 \times 10^6$ l.y., the lag axis extending for 4 million l.y., and the short axis for 1 million l.y.; the probable velocity of recession is 4400 km./sec., for the eastern (nearer) end of the cluster. A. S. D. M.

PLANETS.

3001. Photo-Relay Study of Lunar Microrelief. S. G. Natanson. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 2 *pp.* 77–78, 1937. *In English.*—Since a star occulted by the moon projects a shadow of its edge on the earth, an isochrone of such observations by a chain of observers would reproduce the outline of the lunar shadow. Its velocity being on an average 1 km./sec., this is a possible method if a common-recording clock is used for the isochrone series. The author considers the effect of starlight diffraction by the lunar edge; he describes his own design of a tube which, when placed in the focus of a 1 m. mirror, is capable of recording automatically the light of stars down to 5·5 magnitude.

This method may be adjusted to register light down, not to complete disappearance, but to a proportion, say, 50% of the whole. A. S. D. M.

STARS.

3002. Statistical Determination of Masses and Parallaxes of Binary Stars. C. Barnes. *Roy. Astron. Soc., M.N.* 97. *pp.* 454–457, *April*, 1937.—The combined mass and the parallax of a binary system are related by an expression which involves also the semi-axis major of the true orbit and the period. Where these latter quantities are unknown, however, the mass and parallax may be estimated by a statistical process from the apparent separation ρ and the apparent relative motion ω. The formulæ given contain numerical coefficients whose values are found theoretically in terms of the eccentricity e, by calculating the mean values of $\rho\omega^2$ and $(\rho\omega^2)^{1/3}$. The mean values of the squares of these quantities are also computed in order to estimate the probable errors. In averaging these expressions it is assumed that for an orbit of given e, all inclinations of the plane and all directions of the major axis are equally probable. All values of e, however, are not equally probable, and in the final evaluation of the coefficients an observational mean is used. A. Hu.

3003. Density of Components of Eclipsing Variables. E. A. Kreiken. *Zeits. f. Astrophysik*, 13. 4. *pp.* 241–254, 1937. *In English.*—The density of the component of minimum density is computed from:—

$$\log P + \tfrac{1}{2}\log \rho = -0{\cdot}655 - 1\tfrac{1}{2}\log (R_1 + R_2)/R + 0{\cdot}527 \log k \pm 0{\cdot}086.$$

It appeared, that a linear relation of the form $\log \rho = A + B{\cdot}M$, exists between the resulting values of the density and absolute magnitude. The coefficients A and B of this relation vary from one spectral type to the other. The numerical values valid for the various types were obtained from least-squares solutions. The mean density of the giants and dwarfs of the different spectral types were then found from this linear formula. [See also Abstract 2607 (1936).] AUTHOR.

3004. Magnitude Corrections for Interstellar Absorption. W. Gleissberg. *Zeits. f. Astrophysik*, 13. 4. *pp.* 255–265, 1937.—The author points out that the only available corrections of stellar magnitudes to allow for interstellar absorption are based on statistical averages over relatively large regions of the galaxy. The paper presents results of an attempt to determine the individual corrections applicable to 53 stars, of visual magnitude < 6, whose colour excess is known to be due to inter-stellar absorption. The amount of absorption to be expected when light of wave-lengths varying from 3850 to 7050Å is scattered by particles of diameters from 20 to 100 mμ is calculated from previous work by Schalén. Thence, by using the colour excesses previously obtained by the author, the subtractive corrections to be applied to the visual magnitudes of the stars selected are evaluated: they vary from 0·14 to 1·87 mag., with probable errors of the order of 0·1 mag. A mean particle size of 50 mμ best fits the observations and agrees with values otherwise obtained. A. Hu.

3005. Two Visual Binary Orbits. R. v. d. R. Woolley and L. S. T. Symms. *Roy. Astron. Soc., M.N.* 97. *pp.* 438–453, *April*, 1937.—The paper describes the calculation of the orbits of γ_2 Andromedae and 9 Argus, two visual binary stars with highly inclined, highly eccentric orbits. The orbits are computed by correcting published elements thus:—the coordinates x and y of the companion (referred to the primary as origin) are calculated for the epochs of several adopted normal places, and the differences Δx and Δy obtained in the sense normal place minus computed place. Each such difference gives one equation of condition for the differential corrections required; these corrections are then applied to the original elements and a new ephemeris computed. It is sometimes more convenient to use the position angle and separation rather than rectangular coordinates. Previous observations of both stars are critically examined and new elements computed in this way. Ephemerides are given for visual work during the next few years. Both stars are approaching periastron, and velocity-difference ephemerides are also given in the hope that spectroscopic observations will be possible. A. Hu.

3006. Stellar Kinematics and Mean Parallaxes. F. K. Edmondson. *Roy. Astron. Soc., M.N.* 97. *pp.* 473–485, *April,* 1937.—Extension of Milne's work on "Stellar Kinematics and the K-effect" [see Abstract 3344 (1935)] to second order terms shows that, in general, the solar motion as ordinarily defined is a function of the galactic latitude and the distance of the stars to which it is referred. Furthermore, values derived from radial velocities and proper motions in latitude and longitude will not be consistent, in general. Introduction of the special assumptions of galactic rotation does not modify these conclusions. It is shown that the secular parallaxes of distant stars will be made systematically too large by the second-order galactic rotation effect. Mean parallaxes derived from tau-components will also be systematically too large, but the effect is much smaller than for secular parallaxes. In both cases the effect is a function of galactic latitude. The influence of irregularities in the distribution of absorbing material in the galaxy is examined. The relationship between mean parallax and mean distance is discussed. It is pointed out that the product $\overline{\pi} . \overline{r}$ must depend on galactic latitude, and probably varies with apparent magnitude. AUTHOR.

3007. Distribution of Stars in Spectral Classes. H. Brück. *Zeits. f. Astrophysik,* 13. 4. *pp.* 266–293, 1937.—The 17,000 stars of magnitudes <13 found in the 24 fields, each covering 16 square degrees, which comprise the Potsdam $-30°$ zone are statistically surveyed. The scheme of spectral classification employed is compared with the Harvard and Bergedorf systems. In the main statistical table, 8 spectral classes, conterminous but not coincident with the Draper letters B to M, are distinguished. Within each spectral class, the number of stars in each of 10 magnitude categories is entered for every field. The distribution of stars of various brightness amongst the spectral classes is shown graphically and compared with the Harvard and Mt. Wilson results. The distribution of the various spectral groups in galactic latitude is shown graphically, magnitude by magnitude. The usual concentration of B- and A-type stars in the galactic plane is greater than can be wholly explained by observational selection. Graphs also show how the density of stars in 4 spectral groups depends on distance from the sun for 5 zones of galactic latitude. The results are throughout compared fully with those for the $-45°$ zone. A. Hu.

3008. Evolution and Internal Constitution of Eclipsing Binaries. K. Walter and Z. Kopal. *Zeits. f. Astrophysik,* 13. 4. *pp.* 294–312, 1937.—Walter regards the views of Kopal [see Abstract 5467 (1936)] as premature and unsupported even by his own data. A survey of 200 eclipsing binaries, including the 36 used by Kopal, shows that the great majority fall into one of two groups, one comprising systems with components of equal density and great ellipticity (the β Lyrae type), the other systems with a weak component of low density and great ellipticity, and a bright, dense, undistorted component (the "special Algol" type). The density-ratio of the components, however, on Kopal's theory should vary uniformly with the age of the system, and no such grouping would be expected. Kopal's correlation between the radii-ratio and the separation of the components is accordingly explained otherwise. The increase postulated by Kopal in the density concentration of the components as the system ages is considered unlikely, and his correlation between density concentration and spectral type is not regarded as real. Kopal points out that the observed grouping of binaries about two favoured density-ratios involves Walter's conclusion that the density-ratio remains constant during evolution in many physical difficulties. Moreover, if attention is confined to the 66 systems of Walter's 200 for which accurate masses are known, no such grouping is evident. Fundamental reasons are given for regarding as inadmissible, and indeed as the reverse of the truth, Walter's view that the "special Algol" binaries are in an early stage of evolution. The existence of some correlation between density concentration and spectral type is reaffirmed, though the inaccuracy of the observational material is admitted, and support is given from independent evidence. In a restatement of his position, Walter attributes the difference between his views and those of Kopal to a fundamentally different conception of eclipsing binaries: whilst he insists on two groups of divergent evolution and probably of different origin, Kopal treats the groups merely as different stages of development of the same type of system. Finally, Kopal points out that from the principle of conservation of momentum, tidal action in the components of a binary system will tend to increase their orbital separation, and thence to decrease their ellipticity. Thus the β Lyrae type must evolve into the Algol type. General hydrodynamical principles are similarly advanced to support the reality of the correlation between density concentration and stage of evolution. A. Hu.

3009. Spectroscopic Triple Star 113 Herculis. R. Tremblot. *Comptes Rendus*, 204. *pp*. 1309–1311, *May* 3, 1937.—This system has hitherto been supposed to consist of 2 components of types G0 and A3. Radial velocity measurements made 25 years ago on the former fixed the orbital elements on this assumption. In an attempt to obtain the mass-ratio from the mass-function of the A component, the author has measured its radial velocity from the only suitable line, viz. the narrow K-line superposed on the broad band due to the G star. Measurements extending from July to Sept. 1936 suggest rapid variations in radial velocity which cannot be explained by mere duplicity in the system. Moreover, the line sometimes appears double. A ternary system of mass-ratio $(m_1 + m_2)/M = 2$ approx. is postulated, the A component being itself a spectroscopic binary of short period. Comparisons are made with β Capricorni, which shows similar variations of radial velocity. The author emphasises the need for further measurements at higher dispersion, and points out the importance of the system to students of the three-body problem. A. Hu.

3010. Periodic Variation in Spectral Type of δ Cephei and ζ Geminorum. F. Becker. *Zeits. f. Astrophysik*, 13. 4. *pp*. 313–315, 1937.—The variations in spectral type with phase of the variables δ Cephei and ζ Geminorum are determined from measurements of 44 spectrograms of the former and 29 of the latter star, the exposures of which are uniformly distributed over the various phases. In the case of δ Cephei the spectral variation ranges from F1 to G4 and maxima and minima coincide with those of the visual light curve. For the same spectral type the brightness is less on the increasing than on the decreasing flank of the curve. In the case of ζ Geminorum the type ranges from F5 to G4 and the spectral curve is asymmetrically displaced with respect to the visual light curve, the displacement of the maxima being greater than that of the minima.

J. E. K.

3011. Statistical Relationships in the Cepheid and Long Period Variable Stars. A. E. H. Bleksley. *Zeits. f. Astrophysik*, 13. 5. *pp.* 333–346, 1937. *In English.*—By the application of correlation methods to the photographic material obtained on the light curves of Cepheid variables by the Harvard observers, it is found that the period is correlated with the maximum spectral type, the minimum type, the median type, the magnitude type; the range in spectral type is correlated with the range in magnitude and the median type. The interpretation of these correlations is given.—The period-luminosity-spectrum relation for the Cepheids is found in a form involving the bolometric absolute and surface magnitudes. The period-spectrum, period-luminosity and luminosity-spectrum equations are also derived. It is shown that the period-luminosity-spectrum relation is derivable from the period-density and mass-luminosity relations. Similar considerations applied to the long period variables show that the period is significantly correlated with the visual amplitude, and with the spectral type of maximum, but that the amplitude and spectral type are not correlated. AUTHOR.

SUN.

3012. Prominences of the Active and Sunspot Types. R. R. McMath and E. Pettit. *Mt. Wilson Observat., Contrib. No.* 568. *Astrophys. J.* 85. *pp.* 279–303, *May*, 1937.—A short description is given of the equipment and methods. The ejection of bright flocculi within sunspot groups is described; probably these do not rise sensibly above the chromosphere since spots near the limb do not show them; their velocity is about 100 km./sec., at intervals of about 1 hr. The motions of knots and loop ends of sunspot type prominences show the first law of motion of eruptives (uniform motion, broken at intervals by sudden increased velocities) and may show the second law also (when the velocity changes, the new is a simple multiple of the old); many of these originate at great chromospheric heights, and their simplest explanation is that there is chromospheric atmosphere in the Corona (the objections to this are stated). The authors add a new class IIId for eruptive prominences [see Abstract 5044 (1936)] in the "surges" described as having analogy to ocean fall and rise on a coast line; the first motion law prevails here also. Quasi-eruptions form a link between active and eruptive types; the active type obeys both laws of motion. 7 plates are given. A. S. D. M.

3013. Solar Radiation and Atmospheric Polarisation Research. C. Jensen. *Gerlands Beitr. z. Geophys.* 50. 1. *pp.* 44–54, 1937.—The optical processes connected with direct solar radiation and polarisation phenomena are discussed and it is shown that the two sets of measurements are complementary and both are required to become acquainted accurately with many of the factors influencing the transmission of light. The correlation coefficients between them for widely separated places are examined for the existing criteria for purity which generally influence their value. Finally the problem is indicated which is concerned with the determination of the height of the turbid layers. R. S. R.

See also Abstracts 2997, 3033, 3285, 3287.

GEOPHYSICS.

GEODESY.

See Abstract 2957.

GEOPHYSICS, APPLIED.

3014. Seismic Refraction Methods in German Geophysical Survey. H. Reich. *Beitr. z. angew. Geophys.* 7. 1. *pp.* 1–16, 1937.—The method found most suitable in the Geophysical Survey of the N. German plain (Hanover, Holstein, etc.) was a combination of disperse and lineal shots with refraction measurements. A lineal relation was found between seismic wave speed and depth to the Upper Chalk. The speed in the uppermost superincumbent layer is 2000 m./sec., and in the chalk 4000. Thus the time taken to travel 4 km. increases linearly with the depth to the chalk. Elsewhere there seem to be more than one stratum concerned, the speed in successive layers averaging 2300, 3000, 4000 and 5000 m./sec., but there is not enough evidence to show that such increase is not solely due to increased depth. C. A. S.

See also Abstract 2957.

HYDROSPHERE, PHYSICS OF THE.

3015. Friction in the Tidal Currents of the English Channel. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 133–142, *May,* 1937.—Reference is made first to the results obtained by Defant and by Doodson and Corkan on the tides in the English Channel and to the author's results for the Bristol Channel. In this paper the frictional force per unit area of the sea-bottom is determined for the semi-diurnal tidal motion at intervals along a median line roughly from Ramsgate to Calais and from Newhaven to Le Havre. From the agreement of observed and calculated values of the current in the English Channel it is inferred that the narrow sea theory provides a good approximation to the motion in the area considered. The phase is found to be roughly the same as that of the current but the friction varies considerably from section to section in a linear way with depth and is less than in the Bristol Channel. The skin friction of water over the sea-bottom cannot be assumed to be given universally by $k\rho V^2$ where $k = 0{\cdot}002$. For the Bristol and English Channels the mean values are 0·0026 and 0·0093 respectively. R. S. R.

See also Abstract 3017.

LAND, PHYSICS OF THE.

3016. Investigation of Interior of Earth by Measurements of Emanation. G. Aeckerlein. *Phys. Zeits.* 38. *pp.* 362–370, *May* 15, 1937.—The radioactivity (averaging some ten times that of air drawn from similar places) of the water (I), and the comminuted rock (II) obtained at various depths when making a boring, 120 m. deep, in gneiss at Annaberg in the Erzgebirge, were determined, and the Rn and Ra contents respectively plotted against depth. The two curves agree closely when that for I is shifted as though for 2·5 m. deeper, as also does that for the ratio I/II. A marked increase was found when a fissure which gave an increased supply of water and some indications of ore was passed through. The reasons for the variations (a probable coating of radioactive material on the walls of pores, and greater ease with which such material can emerge where the rock is more porous) are discussed in detail, and the value of the method in prospecting is stressed. C. A. S.

3017. Structure of Continents and Ocean Basins. R. M. Field. *Washington Acad. Sci., J.* 27. *pp.* 181–195, *May* 15, 1937.—A review is made of the growth of ideas, theories and hypotheses on continental and ocean structure especially in relation to future geophysical-geological research. Palæography, especially of the pre-Mesozoic history of the earth, is the most important. Physiographic and structural data of the sub-oceanic lithosphere are required and these will throw light on such questions as isostasy, geosynclines and continental drift. Available data suggest that diastrophism, or major deformation processes, is relatively independent of surficial lead such as occurs under conditions of erosion and deposition. Geophysical techniques are, or soon will be, ready to make the geophysical survey of ocean basins and for this international co-operation is required. R. S. R.

3018. Poleward Flow of Continents. K. Wegener. *Gerlands Beitr. z. Geophys.* 50. 1. *pp.* 100–103, 1937.—Doubt exists regarding the mathematics of the poleward flow of continents as given by Epstein, Lambert, and Prey, not only in the order of magnitude but also in the direction and sign. Under certain circumstances the problem is incomplete and in the paper the elementary and experimental basis of the problem is given to provide a firm outline for consideration, which can then be extended to the limits of the power of presentation. R. S. R.

METEOROLOGY.

***3019. Variation of Lapse Rate of Temperature near Ground at Ismailia, Egypt. W. D. Flower.** *Meteorolog. Office, Geophys. Mem. No.* 71. [87 *pp*.], 1937.—This memoir deals with a continuous set of observations taken between Oct. 1931 and Oct. 1932. The points of observation were at heights 1·1 m., 16·2 m., 46.4 m. and 61·0 m. above the ground. Following a detailed description of the apparatus used and a discussion of the possible causes of inaccurate records, the author proceeds to an investigation of the results obtained. Curves of mean diurnal variation of the lapse rate are found. Extreme values are dealt with. The influence of clouds, the lapse rate associated with the development of radiation fog and nocturnal inversions are discussed in turn. Thereafter the author turns his attention to the relation between wind velocity, temperature and vapour pressure when the lapse rate is zero, then to the mean diurnal variation of temperature at the four heights, under different conditions, and also to lapse rate, vertical gradient of wind velocity and wind velocity. The paper concludes with a discussion of some characteristic charts and the associated anemograph records. The memoir contains numerous illustrations and tables. A. E. M. G.

3020. Air Currents in Rain Showers. G. A. Suckstorff. *Naturwiss.* 25. *pp.* 337–346, *May* 28, 1937.—The water vapour in the atmosphere is the principal source of energy. Temperature changes cause condensation and evaporation and set up currents of air which may travel with uniform velocity or, in certain cases, with considerable acceleration. Since in showers the agitation is not so violent, it is possible by means of gliders to determine the air currents both inside and outside the clouds from which the precipitation occurs. Behind a cloud and in the region where rain is falling, the air current is downwards and the rate of fall of temperature from the ground upward is found to be less under the cloud than in the open. It is found that no true representation of the disturbances in the atmosphere can be obtained, either by measuring pressure, temperature and wind changes at one place on the earth's surface or by obtaining the vertical wind measurements above this point. However, if continuous records of pressure are made at two or more adjacent stations it is possible to get a fairly good idea of the circulation of the atmosphere. H. M. B.

3021. Front Shifting in the Atmosphere. I. Kibel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 7. *pp.* 429–431, 1937. *In English.*—This is an outline of a longer paper to be published in the Transactions of the Main Geophysical Observatory (Leningrad). The motion of two air masses separated by a frontal surface is considered. The general equations of motion are first given. From these and the conditions of the particular problem a system of equations is derived, which may be solved. Hence if the shape of the frontal surface together with the component velocities and the pressure at the earth's surface be known at the initial moment, then the motion of the air masses and the shape of the frontal surface for any subsequent time can be determined.

A. E. M. G.

***3022. Smoke of Cities. J. S. Owens.** *Inst. Mech. Eng., Proc.* 134. *pp.* 211–247 ; *Disc.*, 247–275, 1936.—The measurement of pollution of the air by smoke has been systematically carried on in this country for nearly 25 years, and the methods used for this purpose are briefly described. Certain specific problems connected with air pollution, such such as " smoke pollution and health," " ventilation," " cost of smoke," " height of chimneys," and " trapping of flue dust " are then discussed. A good deal of attention is given to the measurement of smoke as emitted from chimneys, and the different measures which might possibly form bases for by-laws are discussed under the headings of " blackness," " smoke density," and " total impurity emitted." A description is given of a new instrument for measuring the optical density of smoke by means of revolving vanes which can be adjusted to give a grey appearance of various shades when held in front of a white background, or in front of the sky beside the smoke leaving a chimney. The percentage of obstruction of light by the vanes is varied mechanically during observation and made to match the smoke, when a direct reading of light obstruction is given. Finally, a method of fixing limits for smoke emission is described.

AUTHOR.

3023. Quantity of Dust or Smoke at Ground-Level. L. Herman and Renée Herman-Montagne. *Comptes Rendus,* 204. *pp.* 1441–1443, *May* 10, 1937.—The data were obtained at the Institut de Physique Genérale de l'Université de Lyon in 1935 and 1936. The curves representing mean hourly values show two maxima, one between 7 h. and 9 h., the other, less marked, between 18 h. and 20 h. The discussion shows that the position of the maxima of the dust curves depends on meteorological conditions varying from season to season. These maxima should not be attributed to momentary increases in the amount of smoke produced by fires. The mean quantity of dust at ground level undergoes regular variation in the course of the year, perhaps mainly due to domestic fires. A. E. M. G.

3024. Photoelectric Measurement of Diurnal Variations in Daylight. W. R. G. Atkins, N. G. Ball and H. H. Poole. *Roy. Soc., Proc.* 160*A*. *pp.* 526–539, *June* 15, 1937.—Na and Se photo-cells were compared, and their stability was tested, after which one of each type was used to measure the vertical component of daylight in England and in Ceylon. For the same altitude of the sun the intensity around 410 mμ, as measured by the Na cell, is usually less in Ceylon than in Plymouth. For 90° altitude an illumination of about 120 kilolux on the K cell-carbon arc scale is obtained in Ceylon. This scale agrees well in England, in bright mixed daylight, with the Se cell artificial mean noon sunlight scale. With the Se cell the agreement between determinations in England and in Ceylon is far closer than with the Na cell. The value found for 90° altitude is about 145 kilolux but the maximum observation was 155 kilolux in both Plymouth and Colombo. No evidence could be found for considering the average value of the illumination from sun and sky as more than a very rough approach to constancy with a solar altitude 45°, the individual values for sun and sky might be doubled or halved for the same altitude. Twilight, as reckoned down to an illumination of one lux, lasts about 40 min. in Plymouth in early October and 16 min. in Ceylon in early May, but the illumination at sunrise or sunset on a clear day is the same, about 700 lux on the Se cell scale. The total illumination from the sky as received upon a small globe is usually more than the theoretical twice the vertical uniformly diffuse light, since reflection from the ground or sea increases it and a blue sky is generally brighter near the horizon; so the ratio is increased up to about 2·7. The ratio of sunlight to sky light (V_s/V_d) may be as much as 4 for 410 mμ and 90° altitude, but may be over 8 for the middle of the visible spectrum. [See also Abstract 3125 (1936).] AUTHORS.

✱3025. Ground Apparatus for Aircraft Meteorological Services. J. Grunow. *V.D.I.* 81. *pp.* 477–481, *April* 24, 1937.—Details are given of the equipment of a meteorological station to measure (1) visibility with slit, wedge, or cone visibility meters, (2) cloud height with ceiling projector or range finder, (3) cloud speed with mirror nephoscope, (4) wind speed at ground level with cup or pressure-tube anemometer and upper winds with pilot balloons and (5) temperature and humidity with distant reading thermometers. R. S. R.

See also Abstracts 3013, 3274, 3286.

SEISMOLOGY.

3026. Seismic Vibrations in Buildings. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 21–32, March, 1937. *In English.*—The resonance curve of the vibration of a building can be flattened in two ways. The dissipation of energy into the ground can be rendered more effective [see Abstract 5486 (1936)]. It is also possible to install a vibration damper within the building. In this paper the theoretical characteristics of such an apparatus are investigated. W. A. R.

3027. Seismic Determination of a Reflecting Plane. F. Gassmann. *Beitr. z. angew. Geophys.* 7. 1. *pp.* 17–20, 1937.—From determinations by means of three suitably placed seismometers of the velocity and travel times of elastic waves proceeding from a focus and reflected from a plane of unknown position it is shown how to deduce the position of the plane. C. A. S.

3028. Focal Depth of Very Distant Earthquakes. C. Bois. *Comptes Rendus,* 204. *pp.* 1493–1495, *May* 19, 1937.—The focal depths of 12 distant (> 11,000 km.) earthquakes (focal depth > 100 km.) as determined from (I) Brunner's curves and (II) Gutenberg's tables [see Abstract 1141 (1937)] applied to Strasbourg records, are compared showing an average excess of 10 km. by method I. The results are generally of a similar order to those deduced by other methods so far as available [see Abstract 1588 (1937)]. C. A. S.

3029. Earthquake Statistics. E. Wanner. *Gerlands Beitr. z. Geophys.* 50. 1. *pp.* 85–99, 1937. *English Abstract.*—Poisson's method, as subsequently modified, has been used to investigate statistically the earthquakes contained in the Oxford Catalogue of Earthquakes, 1925–30. It is shown that if the after shocks are eliminated the earthquakes are independent of one another. No phenomenon is apparent which can start earthquakes simultaneously over the whole globe while the occurrence of "relay" earthquakes is unimportant. These relations for the whole earth are not so certain over smaller areas such as for the near earthquakes of Central Europe and investigations in other areas are needed. R. S. R.

3030. World Distribution of "Deep" Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 170–178, *March,* 1937. *In English.*—Reference is made to Conrad's results regarding periodicity of deep-focus earthquakes [see Abstract 133 (1934)]. Epicentres are plotted on a map of the world to show frequencies, and contour lines are drawn for focal depths ≧700 km., 500–700 km., 300–500 km., and 100–300 km. to show the geographical and vertical distribution. The hypocentral transfer in the vertical direction is discussed for the world's "deep" earthquakes and for the "felt" earthquakes in the Kwanto district. Finally the periodicity of "deep" earthquakes was investigated and the probable periods of occurrence were obtained.
R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3031. Nature and Origin of Large Ions in Atmosphere. G. Nadjakoff. *Comptes Rendus,* 204. *pp.* 1236–1238, *April* 26, 1937.—That some at least of the atmospheric large ions are minute particles of soot is shown by the fact that when two wires were stretched in a place shielded from air currents and along one of them (I) d.c. (100 V) was passed, and along the other (II) a.c. (150 V), and thus maintained for several years, a mass of fine sooty particles collected on I and little or none on II, the sooty particles behaving exactly as large ions in the non-alternating electric field. C. A. S.

3032. Lightning Flash and its Component Strokes. J. G. Albright. *J. of Applied Physics,* 8. *pp.* 313–318, *May,* 1937.—An apparatus for the observation of lightning flashes consisting of 8 cameras mounted on a disc revolving about a vertical axis is described. A subsidiary part consisting of 3 stationary cameras enables "still pictures" of the flash to be got for comparison purposes. Photographs of a lightning flash which occurred at Cleveland, Ohio, on Aug. 22, 1936 are reproduced and discussed. The author infers from this series and the photographs of other observers that (1) the cloud is positive with respect to the earth as a rule; (2) all component strokes are preceded by a leader except the first; (3) the direction of the leader is from the cloud to the earth; (4) the main stroke following the leader travels in the opposite direction. A. E. M. G.

3033. Separation of Charges by Pressure Gradients in a Body. H. Haalck. *Zeits. f. Physik.* 105. 1–2. *pp.* 81–87, 1937.—From certain general considerations of the forces between electrons and protons within the sphere of molecular action, it is postulated that a charge separation occurs in the interior of the earth, the inner portion of the earth being positively charged and the outer shell negatively charged. The rotation of the earth with such a charge distribution will give rise to a magnetic field, the direction of which is similar to that of the terrestrial field. A quantitative estimation of the magnetic properties of the sun and the earth and of the magnitude of the charge separation in their interiors is attempted; the space charge per c.c. at the centre and the surface of the earth is given as $+ 11 \cdot 4$ to $5 \cdot 0 \times 10^{-14}$ and $- 3 \cdot 8$ to $- 5 \cdot 0 \times 10^{-14}$ e.m.u. respectively whilst the corresponding figures for the sun are $+ 2 \cdot 4$ to $1 \cdot 1 \times 10^{-14}$ and $- 0 \cdot 8$ to $- 1 \cdot 1 \times 10^{-14}$ e.m.u. These figures are of value in computing the Zeeman effects in the sun's spectrum, a quantitative agreement being found. Little change is observed in the figures given if the positive charge excess is taken as the 1st, 2nd or 3rd power of the distance from the centre. The relation between the earth's magnetic field and the known facts concerning atmospheric electricity are discussed qualitatively and quantitatively. In conclusion, attention is drawn to the fact that modern theories of the molecular structure of matter are here applied to an explanation of terrestrial magnetism. H. J. H. S.

***3034. Dip Variometer. T. Nagata.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 185–192, *March*, 1937. *In English.*—The principles to be embodied in the design and construction of the instrument are first discussed and full details are given of the instrument constructed to satisfy these requirements and of its adjustment and calibration. The results of tests made in Tokyo when electric trolley cars were not running, are given. The instrument is now in use at the foot of Mt. Asama to determine changes in dip during volcanic activity. R. S. R.

3035. Earth Currents during the Solar Eclipse of June 19, 1936. R. Takahasi. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 109–112, *March*, 1937. *In English.*—Simultaneous observations of the variations in the intensity and direction of the earth current were made with instruments of increased sensitivity and recording speed at permanent earth current stations set up in the Kwanto district. Full details are given of the apparatus used, and the method employed. A remarkable earth current storm lasted from 6 hr. before the eclipse until 8 hr. after its end which was coincident with a remarkable magnetic storm observed at this time in Hokkaido and Manchukuo, and the variations of the two are similar. Normally in this region magnetic storms have little effect on the earth current. Changes in the intensity and height of the ionised layers, which may have caused the effects observed, are discussed. R. S. R.

See also Abstracts 3285, 3287.

RADIOACTIVITY.

3036. Nuclear β-Rays of Radium D. H. O. W. Richardson and Alice Leigh-Smith. *Roy. Soc., Proc.* 160*A*. *pp.* 454–463, *June* 1, 1937.—The nuclear electrons of Ra D have been studied by photographing the tracks of the β-rays from a radioactive vapour of Ra D in a cloud chamber. As a result of measuring the β-ray tracks emitted in 107 Ra D disintegrations it is concluded that 57 ± 8 % of the nuclear electrons have energies below 4 kV and that not more than about 3 % can have energies exceeding 13 kV. This is consistent with a Konopinski-Uhlenbeck end-point at about 24 kV or a Fermi end-point of about 16 kV. No evidence for the presence of a " long-range " β-transition between the ground states of radium D and E was found and, if present, it must occur in less than about 10 % of the disintegrations. AUTHORS.

3037. β- and γ-Rays of Elements beyond Uranium. L. Meitner. *Ann. d. Physik*, 29. 3–4. *pp*. 246–250, *June*, 1937.—The rays of the elements obtained by bombarding U with neutrons are photographed in a Wilson chamber in a magnetic field. The source is always a mixture of all known elements beyond U, but by varying the time of exposure and the time interval between the exposure to the neutrons and the photographs, samples can be obtained containing predominantly the elements with short or those with long life-times. In this way estimates of the maximum energies of the electrons emitted by the different elements are obtained. Preliminary experiments show that several of these elements emit γ-rays. R. P.

3038. Matrix Element in Fermi's Theory of β-Decay. L. W. Nordheim and F. L. Yost. *Phys. Rev.* 51. *pp*. 942–947, *June* 1, 1937.—It is investigated how the Fermi theory of β-decay has to be formulated for a complex nucleus containing many particles. By symmetrising the problem in all particles (neutrons and protons) a general prescription is obtained which would allow one to calculate the transition probabilities when the wave functions for the nucleus in its initial and final state are known. The discussion of the heavy particle matrix element which is involved shows that a considerable decrease of the transition probability with the complexity of the nucleus is to be expected. A new reduction of the empirical data shows that the influence of the Coulomb field on the β-disintegration probability is larger than heretofore assumed. The difference obtained in reduced lifetimes of light and heavy nuclei (of the order of a factor 50 to 100) is of the same order of magnitude as estimated from the theoretical considerations. AUTHORS.

3039. Rapid Means of Identification by γ-Radiation of Actinium, Radiothorium and Mesothorium. Catherine Chamié. *Comptes Rendus*, 204. *pp*. 1328–1330, *May* 3, 1937.—Tubes containing (*a*) the substance under examination, and (*b*) Ra are placed at various (both the same) distances, up to 45 cm., above a sheet of Pb 1 cm. thick laid on top of the ionisation chamber, which is a cylindrical condenser diam. 50 cm., height 5 cm. The ratio of the γ-radiation from the pair of tubes is plotted against their height above the Pb plate. The curves given by Ac and RaTh are characteristic, that for MsTh varies with its age, but is sufficiently characteristic except during the time when the ratio is constant for measurements at all heights. [See Abstract 2280 (1924).] C. A. S.

See also Abstracts 2882, 3016, 3156, 3209, 3211, 3244, 3245.

RADIATION.

ABSORPTION AND TRANSMISSION.

3040. Analogue of Beer's Law for Coloured Layers. H. E. I. Neugebauer. *Zeits. f. techn. Physik*, 18. 5. *pp.* 137–139, 1937.—Beer's law for the transmission of light through filters is discussed and the possibility of applying it in a modified form to coloured layers is examined. Coloured layers (such as colour films) consisting of small crystallites with a backing (which may be transparent or coloured) are considered and a general formula is deduced which may be regarded as a type of Beer's law (surface reflection is neglected). The formula is then discussed in relation to opaque and glazed coloured layers. The microscopic structure of the layer gives information concerning certain constants in the formula and their relations with the number of coloured particles. H. J. H. S.

3041. Relative Coefficients of Absorption of Ozone. Arlette Tournaire-Vassy. *Comptes Rendus*, 204. *pp.* 1413–1414, *May* 10, 1937. —Values published for the u.v. absorption coefficients of O_3 are not in agreement, probably because of the uncertainty about the amount of O_3 absorbing. Using a tube in the form of a cross and measuring the u.v. absorption down one arm and the visible down the other, self-consistent coefficients for the whole region are obtained. H. G. C.

See also Abstract 3290.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3042. Paramagnetic Rotatory Power of Hydrated Ethylsulphate of Erbium and Paramagnetic Saturation. J. Becquerel, W. J. de Haas and J. van den Handel. *K. Onnes Lab., Leiden, Comm. No.* 244*b*. *Physica*, 4. *pp.* 345–352, *May*, 1937. *In French.*—It is shown that hydrated ethylsulphate of erbium follows, for the optic axis, at temperatures between those of liquid helium and liquid hydrogen, a very simple law of paramagnetic magnetisation. The paramagnetic rotation of monochromatic light is a function only of H_e/T, where H_e is the effective field, and the fraction of saturation is represented by a hyperbolic tangent of which the argument is the variable of Langevin. At liquid helium temperatures paramagnetic saturation is reached in fairly low fields. This is the total magnetisation, as there is no paramagnetic term independent of the temperature. [See also Abstract 610 (1937)]. G. E. A.

3043. Thermal Variation of Magnetic Rotatory Power. H. Ollivier. *Comptes Rendus*, 204. *pp.* 1326–1328, *May* 3, 1937.—The thermal variation of the magnetic rotatory power of the two groups of salts (*a*) nitrates of Mn and Cd, (*b*) nitrates of Ce, Nd and Pr, has been examined. The first group obey a law analogous to the Weiss law of paramagnetism whilst the second group exhibit only very feeble magnetic rotatory properties. W. R. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3044. Kathodoluminescent Spectrum of Danburite. S. Iimori and J. Yoshimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 691. *pp.* 225–228, *April*, 1937.—The mineral is a sort of calcium borosilicate. The spectrum is described as three band groups between 660 Å and 560 Å, each group consisting of four or more well defined narrow bands. In addition there are a number of weak diffuse bands in the green-blue and violet. The narrow bands are compared with well-known lines of Eu and Br. Alternatively it is suggested that they may be boron oxide bands. J. E.

3045. Kathodo-Luminescent Spectra of Feldspars and Other Aklali Alumino-Silicate Minerals. S. Iimori and J. Yoshimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 696. *pp.* 281–295, *May,* 1937. *In English.*—Thermo-luminescent feldspars from four different sources gave luminescence under the influence of kathode-rays which was practically identical and consisted of three bands. These spectra are compared with those of other minerals. W. R. A.

3046. Air Afterglow and Thermal Radiation of NO_2. V. Kondratjew. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 320–325, 1937. *In English.*—It is shown that the spectrum of the air afterglow is identical with that emitted by NO_2 at high temperatures. It follows that NO_2 is the carrier of the band part of the afterglow. A preliminary analysis of the band structure of the spectrum has been made. The advantages of the thermal method of excitation in studying molecular emission spectra is pointed out. AUTHOR

See also **Abstracts 3076, 3179.**

INTERFERENCE, DIFFRACTION AND SCATTERING.

3047. Sagnac Phenomena with a Bright Stationary Light-Source. A. Dufour and F. Prunier. *Comptes Rendus,* 204. *pp.* 1322–1324, *May* 3, 1937.—Using a bright stationary light source in conjunction with a Sagnac interferometer gives results identical with those from previous methods. W. R. A.

3048. Classical Theory of Diffraction with an Extended Source. F. Wolfers. *J. de Physique et le Radium,* 8. *pp.* 185–192, *May,* 1937.—A complete solution is given for the problem of diffraction at a straight edge illuminated by a source of finite width, the accuracy of the calculation being greater than that which can be obtained experimentally. C. B. A.

3049. Dispersion of Depolarisation of Light Scattering in Colloids. Part II. R. S. Krishnan. *Indian Acad. Sci., Proc.* 5*A. pp.* 305–320, *April,* 1937.—Investigations previously reported on Au sol [see Abstract 2058 (1937)] are extended to six unprotected Ag sols. Measurements of the dispersion of depolarisation of scattered light, the incident light being unpolarised and polarised horizontally and vertically suggest that the particles are optically equivalent to a prolate spheriod of axis ratio 0·75. H. G. C.

3050. Scattering of Light by Water. L. H. Dawson and E. O. Hulburt. *J.O.S.A.* 27. *pp.* 199–201, *June,* 1937.—By means of quartz spectrograph and recording densitometer measurements were made throughout the spectral region from 5790 to 2536 Å of the relative intensities of light scattered by pure water. The scattering coefficient was found to increase with decreasing wave-length in fair agreement with the $\lambda^{-4}f(\mu)$ expression of the density fluctuation theory. AUTHOR.

3051. Scattering of Light by Light. A. Achieser. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 263–283, 1937. *In German.*—According to Dirac's theory of the positron, light quanta will scatter each other. The effective cross-section for this process had been calculated by several authors for the case in which the energy of the light quantum is less than mc^2 (m = electron mass, c = light velocity). The calculations are now carried out for the other extreme case in which the energy of the light quanta is large compared with mc^2. Owing to great mathematical complications the problem can be completely solved only for small angles of scattering; in the formula for the total cross-section a numerical factor is left undetermined. Apart from this factor the cross-section is $(137)^{-4}$ times the square of the wave-length of the light quanta in that coordinate system in which they have equal and opposite momenta. R. P.

See also Abstracts **2894, 2935, 2971, 2979, 3085.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3052. Optical and Photochemical Experiments with Phosphorus. G. Rathenau. *Physica,* 4. *pp.* 503–514, *June,* 1937. *In German.*—The photochemical reaction, whereby dissolved P_4-molecules form red phosphorus has been found to be a monomolecular reaction. It is concluded that the light absorption causing this reaction is unchanged by neighbouring P_4-molecules and that the reaction consists in a dissociation $P_4 = 2P_2$, the recombining P_2-molecules forming red phosphorus. The light absorption of P_4, uncoloured molten and red phosphorus is studied in the near u.v. region. Increasing absorption with shorter wave-length is found. The measurements are discussed and related with known data from molecular spectra. AUTHOR.

3053. Photochemical Formation of Phosgene. Part IX. M. Bodenstein, W. Brenschede, and H. J. Schumacher. *Zeits. f. phys. Chem.* 35. *Abt. B.5. pp.* 382–402, 1937.—By a method of interrupted illumination it has been possible to measure the decay of the photochemical formation of $COCl_2$. The illumination period was constant at 0·18 sec. while the dark period in between was varied from 0·18 to ·98 sec. The decay could be followed up to 2 sec. after the end of the illumination. The rise and decay functions were calculated from the known reaction-scheme, and accorded well with the experimental results. From this, important constants for the partial reactions were evaluated. If the gases used were not perfectly free of O_2, the after-action lasted sometimes up to 25 sec. This agrees with the fact that small quantities of O_2 retard photochemical phosgene formation. The function of CO_2 from CO and O_2 in the presence of Cl showed after-action of the same magnitude as in the case of the phosgene formation with a trace of O_2 present. [For Part VIII see Abstract 1568 (1935)]. A. C. M.

3054. Photographic Intermittency Effect. A. Kochs. *Zeits. f. wiss. Phot.* 36. *pp.* 97–115, *May–June,* 1937.—Describes the results of an examination of the effect of the type of emulsion on the photographic intermittency effect. Two different types of emulsion were examined. R. C. F.

3055. Infra-Red Photography Beyond 10,000Å. Part III. W. Dieterle and O. Riester. *Zeits. f. wiss. Phot.* 36. *pp.* 141–144, *May–June,* 1937.—The syntheses are described of a typical nonamethine dye of cyanine type, with maximum absorption of 6850 Å, and of benzthio-undekacarbocyanine ethiodide with maximum absorption at 9900 Å and maximum sensitising at 10,200 Å. Plates sensitised with the latter dye are stable at 0° C, whereas the older type (Agfa " 1050 ") had to be stored at − 80° C. [For Part II see Abstract 2561 (1937).] L. V. C.

3056. Rôle of the Protective Colloid in Photography. Lüppo-Cramer. *Kolloid Zeits.* 78. *pp.* 344–348, *March*, 1937.—The reducibility of AgBr depends markedly upon the protective colloid present. In a collodion " emulsion " of AgBr, peptone is particularly effective. Ollendorff and Rhodius' method of preparing unprotected AgBr is repeated and the effects of dyestuffs and of desensitisiers on the course of its development are studied. L. V. C.

3057. Applications of Photography to Scientific and Technical Problems. O. F. Bloch. *Roy. Soc. Arts, J.* 85. *pp.* 651–672, *May* 28, 1937.—A survey is given of some of the uses to which photography has been put in various branches of science. The topics dealt with include astronomy, spectroscopy, radiography, atomic disintegration, cosmic rays, mass spectrography, photomicrography, aerial photography, road illumination, etc. A. H.

✱**3058. Drum Camera for Recording Transient Electrical Phenomena. F. E. Lutkin.** *Journ. Sci. Instruments*, 14. *pp.* 209–212, *June*, 1937.—A drum camera is described which is used in conjunction with a kathode-ray tube for recording the wave form of " atmospherics." The patterns are registered as departures from a very closely pitched helical zero line, and records equivalent to those obtained previously with 1000 ft. of 35 mm. film can now be made on 1 m. of paper 10 cm. wide. AUTHOR.

✱**3059. Photoelectric Densitometer Requiring No Empirical Calibration. E. W. H. Selwyn and F. H. G. Pitt.** *Kodak Research Lab. Comm. No. H*622. *Phot. J.* 77. *pp.* 397–405 ; *Disc.*, 405–407, *June*, 1937.—Deals with the factors influencing the design of a photoelectric densitometer which gives the same results as the visual densitometer without requiring an empirical calibration. The factors considered are the distribution of light and variation of density with angle of collection, reversibility of opal glass and density, and effect of degree of diffusion and inter-reflections. These are followed by a brief description of the densitometer, it being concluded that the requirements of such an instrument are approximate equality of colour sensitivity with that of the eye, result to be quoted with the density of base, or alternatively, fog density as zero, incident light to be an approximately parallel beam, and emergent light to be diffused by an opal glass in contact, minimum thickness of opal glass to be such as to give a reflecting power of 0·45 in diffused light, and the cone of emergent light which falls on the photoelectric cell to have a semi-angle not greater than 30°. R. C. F.

3060. Chlorophyll Effect. R. Mecke and W. C. G. Baldwin. *Naturwiss.* 25. *pp.* 305–307, *May* 14, 1937.—Discusses briefly the reasons why leaves of trees and plants appear bright when photographed by means of infra-red plates. R. C. F.

PHOTOMETRY.

3061. Photometric Theory. J. Dourgnon. *R.G.E.* 41. *pp.* 619–633, *May* 15, 1937.—After defining and explaining the chief quantities used in photometry, the author gives a theoretical treatment of some of the principal laws and methods used in calculation. One section of the paper is devoted to volume sources since this subject is now important on account of the use of discharge lamps. The methods applicable to the calculation of the illumination from extended sources are described in full and the principles governing transmission through an optical system are set out in detail. The properties of scattering media are referred to, particularly as illustrating the law of conservation of luminous flux. In a final section there is a demonstration of the principle that it is impossible to obtain a brightness higher than that of the source of light employed. J. W. T. W.

*3062. **High-Speed Microphotometer. H. B. Vincent and R. A. Sawyer.** *J.O.S.A.* 27. *pp.* 193–197, *May,* 1937.—Describes a microphotometer designed for the routine measurement of spectrograms, the principal aim being speed of operation combined with accuracy. High transmission of the optical system is secured by the use of lenses with very small *f*-numbers. This allows a critically damped galvanometer with a period of 1·3 sec. to be used on the photo-cell, which is of the rectifier type. It is estimated that readings accurate to 1 % can be made on five or six pre-selected lines in 1 min. Full constructional details are given. J. W. T. W.

*3063. **Recording Microphotometer. H. V. Knorr and V. M. Albers.** *Rev. Sci. Instruments,* 8. *pp.* 183–184, *June,* 1937.—A recording microphotometer, which gives an inked record, has been constructed. It utilises a photo-cell as the light sensitive device. The recording is done with a Leeds and Northrup Speedomax recorder. AUTHORS.

*3064. **Microphotometric Record Reducer. E. J. Perepelkin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 1. *pp.* 25–28, 1937. *In English.*—The apparatus comprises essentially two drums and an inter-connecting mechanical linkage. On the one drum a microphotometer record is wound the contour of which is " followed " as the drum rotates by observation of the record through a magnifying glass attached to the mechanical linkage. The linkage includes as adjustable parameters a cam mechanism with a roller sliding on a flexible steel band curved in accordance with the characteristic of the photographic plate, and a crank carrying a pin whose distance from the axis is fixed in accordance with the background density of the plate. On the second drum a true intensity curve is traced by a pen carried by the transforming mechanical linkage. High accuracy and great rapidity is claimed for this apparatus. J. E. K.

See also Abstracts 2957, 3024, 3274.

POLARISATION.

3065. **Theory of Optical Rotatory Power. J. G. Kirkwood.** *J. Chem. Phys.* 5. *pp.* 479–491, *June,* 1937.—The Born theory of optical activity in quantum-mechanical form is simplified with the aid of certain approximations. It leads to a simple expression for the rotatory parameter of an active molecule in terms of the geometrical configuration and the polarisability tensors of its constituent groups. Optical anisotropy of the component groups and inhibited internal rotation are found to play an important *rôle* in determining rotatory power. The proposed theory has points of similarity both with the polarisability theories of Gray, de Mallemann, and Boys and also with Kuhn's specialisation of Born's classical theory of optical activity. To illustrate its use, the absolute configuration and the specific rotation of *d*-secondary butyl alcohol are calculated. AUTHOR.

*3066. **Polarisation Spectrometer for Investigation of Surface Films on Metals. A. B. Winterbottom.** *Journ. Sci. Instruments,* 14. *pp.* 203–208, *June,* 1937.—The construction adjustment and calibration of a polarisation spectrometer provided with a Sénarmont compensator and an ellipticity half-shade system is described, followed by a brief survey of methods of preparation and examination of surfaces when determining optical constants or surface films. AUTHOR.

See also Abstracts 2995, 3049, 3097, 3099.

RADIATION, EMISSION.

3067. Extensions of Wien's Displacement Law. F. A. Schulze. *Ann. d. Physik*, 29. 3–4. *pp.* 297–301, *June*, 1937.—Relationships are derived from $E\lambda = \lambda^{-5}.F(\lambda T)$ by forming the ρ-th derivation of $E\lambda$ with respect to λ and λT. The equation of the isothermals of black radiation of wave-length λ_ρ is derived in the form $\lambda_\rho T = \text{const.}$ This result is shown to hold for the general case where $E\lambda = \lambda^{-p} F(\lambda T)$, where p has any value whatsoever. Satisfactory agreement is found between theoretical and observed values of the wave lengths corresponding to turning points of radiation isotherms deduced in accordance with Planck's law, and for those of the radiation emitted by certain metals. Similar deductions are derived from the radiation laws $R = \nu^3 F(T/\nu)$, proposed by Wien, and for $R = \nu^p F(\nu/T)$. J. S. G. T.

3068. Tables for Planck's Radiation Formula. Part II. Z. Yamauti and M. Okamatu. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 402. [51 *pp.*], 1937. *In English.*—These tables form a continuation of those previously published in Part I [see Abstract 641 (1937)]. Table III shows the values of $\log_{10}(T/c_2)$ from $\bar{1}\cdot 140$ to $\bar{1}\cdot 350$ at intervals of 0·001, for $c_2 = 14320\mu$ deg., and T ranging from 1977° to 3205° K, and the corresponding values of $\log_{10} E(\lambda T/c_2)$, to 5 significant figures, for every wave-length (λ) from 0·30 μ to 0·76 μ at intervals of 0·01 μ. This table occupies 42 pages and at the foot of each page values of $10T/c_2$ and T_{14320} are shown, which simplify the computation of TC_2, the value of T which corresponds to any other value of c_2, from the equation $TC_2 = T_{14320} + (10T/c_2)\ (c_2 - 14320)/10$. Table IV is intended for use when the equation, $\log_{10}(T_0/c_2) = \log_{10}(T/c_2) + \log_{10}\lambda - \log_{10}\lambda_0$, where $T_0\lambda_0 = T\lambda$, is being evaluated. It gives both values of λ_0 and $(\log_{10}\lambda - \log_{10}\lambda_0)$ for λ from 0·301 μ to 0·759 μ at the intervals of 0·001 μ, taking λ_0 to the nearest wave-length tabulated in Table III. R. W. P.

3069. Nature of Cosmic-Ray Particles. S. H. Neddermeyer and C. D. Anderson. *Phys. Rev.* 51. *pp.* 884–886, *May* 15, 1937.—Measurements on the loss of energy of cosmic-ray particles in passing through a 1 cm. platinum block were made using a counter-controlled cloud-chamber. The particles are found to separate themselves into two well-defined groups, one consisting largely of shower particles exhibiting a high absorbability, the other consisting of particles which in general lose a relatively small fraction of their initial energy. Those in the first group are identified as free positive or negative electrons. It is considered probable that the others are particles with unit charge, but with a mass greater than that of an electron, but much less than that of a proton. D. H. F.

3070. Passage of Cosmic-Ray Particles through Lead Plates. J. Crussard and L. Leprince-Ringuet. *J. de Physique et le Radium*, 8. *pp.* 213–216, *May*, 1937.—A study was made of the loss of energy of cosmic-ray particles in passing through two 0·5 cm. Pb plates, 16 cm. apart in a 50 cm. cloud-chamber in the field of the Bellevue electromagnet. It is found that for particles in the energy range $3 \times 10^8 - 10^9$ eV about half the incident energy was lost on the average by the negative particles, but considerably less by the positives. These comparatively large losses are contrasted with the great penetrating power which has been observed for many particles in the range $10^9 - 3 \times 10^9$ eV. Special mention is made of two exposures showing pairs of electrons, and of a case of nuclear disintegration. D. H. F.

3071. Energy Loss of Cosmic-Ray Particles in Metal Plates. P. M. S. Blackett and J. G. Wilson. *Roy. Soc., Proc.* **160***A*. *pp.* **304–323,** *May* **18, 1937.**—The energy losses of cosmic-ray particles of energies up to 4×10^9 eV were determined by measuring their change of curvature in passing through a metal plate placed in the centre of a counter-controlled cloud-chamber in a magnetic field. It was found that the distortions of the tracks could be reduced by careful temperature control of the apparatus. Pb plates 1·0 cm. and 0·33 cm. in thickness, and a 1 cm. Al plate, were used. The losses for Al were about 1/5 of those for Pb. No certain difference between positive and negative particles could be established. The results are in strong contrast to the predictions of quantum mechanics. It is shown that Nordheim's suggestion for the modification of the radiation formula, that radiation is not emitted when the field strength exceeds a critical value, leads to fair agreement with the facts for low energies. Its failure for high energies is shown to be due to inadequate representation of the atomic screening, and when this is carried out in a more exact manner, by making use of a simple analytic approximation to the Thomas-Fermi field of an atom, an equation is obtained which represents the energy loss results fairly satisfactorily over a range of energy of nearly 60 to 1, within the rather large experimental errors. D. H. F.

3072. Showers Produced by Soft Group of Cosmic Rays. P. Auger and P. Ehrenfest, Jr. *J. de Physique et le Radium,* **8.** *pp.* **204–206,** *May,* **1937.**—Measurements were made on the Jungfraujoch (3,500 m. altitude) with a counter-controlled cloud chamber with a small block of Pt at its centre and sometimes with a block of Pb above the chamber to increase the proportion of incidental shower particles. All four counters used were placed below the chamber in order not to exclude showers produced by non-ionising radiation. The number of showers produced in the Pt by ionising particles was approximately the same as that produced by non-ionising radiation; there was no essential difference in the constitution of the showers produced in the two cases. A statistical study of the angular distribution of the branches of the showers was made. It is considered that the results lend support to the theory that the softer rays present in the atmosphere are shower particles produced higher in the atmosphere, and are themselves capable of producing further showers. D. H. F.

3073. Cosmic-Ray Showers at 4000 m. above Sea-Level. Hu Chien Shan, B. B. Kisilbasch and D. Ketiladge. *Roy. Soc., Proc.* **161***A*. *pp.* **95–107,** *July* **1, 1937.**—At an altitude of about 4000 m. above sea-level, cosmic rays were studied by a quintuple counting method. The results lead to the following conclusions: Showers are produced in different elements according roughly to a Z^2 law as at sea-level. More exactly, the increase of the probability of shower production with the atomic number is slightly less rapid than the Z^2 law. The size of showers increases with increasing atomic number and increasing thickness of the shower-producing material. Thus all rays in an average shower are not produced in a single act. The absorption of shower rays follows an approximate Z law, and thus is due chiefly to extranuclear electrons.

The showers from the lighter elements contain on the average rays of a longer range. The average total energy of showers from different elements may be constant. Showers from lead contain rays of different ranges from a few millimetres up to several centimetres of lead or more. There is no definite range for all shower rays. Since the absorption of the single-shower rays is different from that of the showers as a whole, the argument leading to the identification of the thickness of the shower-producing material at which the maximum of the shower transition curve exists with the range of the shower rays is untenable. AUTHORS.

3074. Structure of Cosmic Radiation. B. Trumpy. *Zeits. f. Physik*, 105. 5–6. *pp.* 341–347, 1937.—Using the counters under a 1·2 cm. plate of Pb the absorption curve of the C-radiation (Geiger's classification) was found, first with only one counter covered with the absorber, then with both covered. The analysis of the results gives no support for the hypothesis that B-photons are liberated in groups from the Pb plate. A comparison of the curves obtained with those published elsewhere using three counters, gives, however, evidence for the occasional existence of several B-photons simultaneously below the upper Pb plate. The frequency of the C-electrons liberated by these B-photons is greatest for a Pb thickness of 0·5 – 0·7 cm. [See also Abstract 5118 (1936).] D. H. F.

3075. Spatial Distribution of Cosmic Rays. H. Geiger and O. Zeiller. *Zeits. f. Physik*, 105. 9–10. *pp.* 517–521, 1937.—Arranged in a circle of dia. 20 cm., are a short curved piece of Pb forming the top of the circle and 9 counters forming the lower semi-circle. Examination is made of the angular distribution of the particles in a shower formed by impact of cosmic rays on the Pb; the mean angle of emission of shower particles is found to be about 20° to the direction of the incident radiation. Experiments with increasing thickness of Pb show a corresponding increase in the angular spread of the components of the shower. F. C. C.

3076. Production of White Light by Electrical Fluorescence of Xenon. M. Laporte. *Comptes Rendus*, 204. *pp.* 1240–1242, *April* 26, 1937.—A simple electrical circuit is described in which the discharge from a condenser passes through a thyratron and a xenon tube. The spectrum emitted is found to be continuous and some of its characteristics are described. [See also Abstract 1192 (1937).] C. B. A.

See also Abstract 3145.

RADIATION, GENERAL THEORY.

3077. Wave Function of a Photon. J. J. Placinteanu. *Comptes Rendus*, 204. *pp.* 1238–1240, *April* 26, 1937.—If a photon is produced by the fusion of two material particles, it is necessary that there should be some kind of interaction-process during the fusion. The author points out that interaction is not easy to conceive if the particles have no mass and are pure charges. He suggests that photons are due to the combination of an electron and a positron which have equal proper-masses. G. C. McV.

3078. Propagation and Absorption of the Neutrino. B. Ferretti. *N. Cimento*, 14. *pp.* 70–75, *Feb.*, 1937.

RADIATION, MECHANICAL EFFECTS.

3079. Dynamical Effects of Radiation in the Solar System. H. P. Robertson. *Roy. Astron. Soc., M.N.* 97. *pp.* 423–438, *April*, 1937. —This examination, from the standpoint of the theory of relativity, of the problem of the retardation of motion of a body receiving and re-emitting radiation, has established the existence of a drag of the same general nature as that predicted by Poynting on classical grounds. The actual expressions for the retarding force, for the case of a spherical particle reflecting or absorbing and re-emitting the radiation it receives from the sun, differ from those obtained by Poynting and by Larmor, even in the approximation to which their considerations were restricted, and it was therefore considered desirable to supplement the rigorous derivation by a brief account of the specific effects arising from the drag in the justifiable approximation in which only terms of first order in the velocity are retained. Those effects of greatest astronomical interest would seem to be the secular decrease of the mean distance of the particle from the sun—of roughly three times the amount predicted by Poynting and by Plummer, or one-half of that implied by the later considerations of Larmor—and the similar decrease in the eccentricity of the osculating orbit, all on the supposition that the direct radiation pressure is not strong enough to reverse the direction of effective gravity. The point of most significance for cosmogony is that this drag, attendant on the pressure due to the solar radiation. constitutes a force which is effective in clearing the neighbourhood of the sun of small particles in astronomically significant times. AUTHOR.

See also Abstract 3193.

REFLECTION, REFRACTION AND DISPERSION.

3080. Reflecting Power of Cu. L. Capdecomme and P. Jacquet. *Comptes Rendus*, 204. *pp.* 1415–1417, *May* 10, 1937.—Polycrystalline surfaces of Cu anodically prepared are shown to have higher reflecting power and to deterioriate less rapidly than surfaces polished mechanically. H. G. C.

3081. Effect of Surface Scratches on Reflection of Light at Polished Crystal Surfaces. M. Berek. *Zeits. f. Krist.* 96. 5. *pp.* 357–364, 1937.—The scratches caused by grinding and polishing of crystal surfaces are examined in reflected polarised light. It is shown that an approximate value for the thickness of the scratches can be obtained by measuring between crossed nicols the " anisotropy parameter " in polarised light which is incident normally on the surface. The author discusses the bearing of the results on microscopical examination of metal surfaces. J. I.

3082. Optics in the Large. M. Herzberger. *Kodak Research Lab., Comm. No.* 617. *J.O.S.A.* 27. *pp.* 202–206, *June*, 1937.—The introduction of the natural and the diapoint variables has simplified considerably the investigation of problems in the large, problems where the eiconal can be given in closed form, and therefore for each object ray the image ray. The author and H. Boegehold have, first together and then alone, investigated problems of this kind. The author sketches first once more his new method, and gives then a series of examples, such as the eiconal for the case where to each object point belongs a rotation symmetric caustic, the eiconal for sharp image formation of two surfaces, the eiconal in the case where there is perfect centric symmetry, and other examples which are discussed as far as the time limit permits. AUTHOR.

3083. Atomic Refraction of Amido-Nitrogen. K. v. Auwers. *Zeits. f. phys. Chem.* 179. *Abt.A.* 1. *pp.* 61–64, 1937.—The atomic refraction of N in the groups $> N - C = O$ and $- N = C - O -$ is discussed. C. B. A.

3084. Relation between Temperature of Transformation and Refractive Index of Glass. Niuta Winter-Klein. *Comptes Rendus,* 204. *pp.* 1470–1472, *May* 19, 1937.—The transformation temperature θ_β at which glass changes from the α-variety to β-variety was found for a number of glasses and also the maximum variation Δn of refractive index between the two varieties. The relation between θ_β and Δn was found to be similar for all glasses, while the curve connecting them leads to certain conclusions as to the constitution of glass. F. S.

See also Abstracts **2912, 2914, 2979, 2992, 2993, 3066, 3135, 3290.**

SPECTROSCOPY.

3085. Interference Measurements of Wave-Lengths in the U.V. Spectrum of Iron. W. F. Meggers and C. J. Humphreys. *Bureau of Standards, J. of Research,* 18. *pp.* 543–557, *May,* 1937.—The wave-lengths of 252 u.v. lines (3498 to 2101 Å) characteristic of the international iron arc were measured relative to Cd, Kr or Ne standards. These measurements were made with Fabry-Perot étalon interferometers and stigmatic spectrographs. Invar étalons of 2, 3, 5, 7·5, or 10 mm. length, and aluminised quartz plates were used. The spectrographs consisted of a concave grating, a Littrow quartz, or a Cornu quartz instrument. With the first, simultaneous exposures were obtained of red Ne lines in the first-order spectrum, and of u.v. iron lines in the overlapping second-order spectrum. The use of quartz spectrographs required alternate exposures of primary and secondary sources. The final values in many cases are given to eight figures since calculations of probable error and tests of relative value by means of the combination principle indicated average errors smaller than 0·0005 Å. AUTHORS.

3086. Actinium Spectrum. (Miss) W. A. Lub. *Comptes Rendus,* 204. *pp.* 1417–1418, *May* 10, 1937.—Using a spark discharge with a dilute solution of nitrates containing 1 in 10,000 of Ac, seven new lines are obtained between 4812 and 4088 Å which are attributed to Ac. H. G. C.

3087. Excitation of Hydrogen and Argon by Atom-Impact. E. Lutze. *Zeits. f. Physik,* 105. 7–8. *pp.* 445–459, 1937.—While the excitation of spectrum lines by electron impact has been explained both experimentally and theoretically, there is little data concerning atom impact, and no corresponding theory. In the present paper the mutual excitation of H and A is investigated, a metal canal-ray tube being used. In the voltage range 0·2 to 1 kV only H is excitated, while above 1 kV the A I spectrum appears and above 2 kV the A II spectrum. The observations are compared with corresponding theoretical presentation. It is sought to explain the causes of the appearance of the A II spectrum. F. S.

3088. Absorption Spectrum of Monatomic Lead Vapour between 2200 and 1600 Å. S. Frisch and V. Černiajew. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 344–350, 1937. *In German.*—At a temperature of 1070° C., more than 20 lines could be measured in each of two series. The terms of the $^3P_1$ and $^3D_1$ series follow the series formula without any irregularities. R. P.

3089. Spectrum of Bromine. Part I. Structure of Br III. K. R. Rao and S. G. Krishnamurty. *Roy. Soc., Proc.* 161*A*. *pp.* 38–48, *July* 1, 1937.—The spectrum of Br has been extensively investigated under different conditions of excitation and about 300 lines have been assigned to Br III. The classifications and term scheme published previously by

Deb have been found to be erroneous and entirely inconsistent with those due to the iso-electronic spectra of As I and Se II, analysed by the writers. An altogether new scheme is now set up, consisting of a system of quartets and doublets. More than a third of the total number of Br III lines are thus classified. The largest term $4p^4S_{1\frac{1}{2}}$ gives the ionisation potential of Br III as 35·7 V. AUTHORS.

3090. Reversal Temperature of the System Containing Sodium and Potassium. H. Yoshinaga. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 386–392, *April,* 1937. *In English.*—By examination of the spectrum emitted by an arc *in vacuo* between an iron rod and a rod made of an alloy of Na and K it is shown that the reversal temperature is the same for both elements and for all series of these elements. A. H.

3091. Absolute Concentration of Excited Atoms in a Low-Pressure Mercury Discharge. V. Fabrikant, F. Butajeva and I. Cirg. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 7. *pp.* 423–426, 1937. *In English.*—By studying the absorption in the discharge of certain lines an estimate is obtained of the atomic concentrations in the three levels $6^3P_{0, 1, 2}$. The values obtained show that the conditions in the discharge investigated were far removed from thermal equilibrium. A. H.

3092. Relative Intensities of Hg Lines. I. L. Fabelinsky. *Phys. Zeits. d. Sowjetunion,* 11. 4. *pp.* 390–403, 1937. *In German.*—The strong intercombination lines in the Hg spectrum show that the spin-orbit coupling, which is usually neglected in theoretical formulæ, is strong. In order to test the influence of this coupling on the line intensities, the intensity ratios of lines starting from a common level are measured, and compared with the theory. The agreement is closest for groups of lines belonging to levels which only give rise to weak intercombination lines. With increasing intensity of the intercombination lines the disagreement increased. Some values are obtained for the self-absorption of the lines 3125 and 2652. R. P.

3093. Broadening of Spectrum Lines by Foreign Gases. C. Reinsberg. *Zeits. f. Physik,* 105. 7–8. *pp.* 460–467, 1937.—A theory is developed to explain the broadening of lines in relation to the series number. The broadening in the neighbourhood of the series limit can be expressed numerically and varies with the temperature. F. S.

3094. Nuclear Spins and Magnetic Moments in the Hartree Model. M. E. Rose and H. A. Bethe. *Phys. Rev.* 51. *p.* 993, *June* 1, 1937.—A correction. [See Abstract 1215 (1937).].

3095. Changes in Magnetic Moments of Atomic Nuclei Due to Additions of Pairs of Particles. H. Schüler and H. Korsching. *Zeits. f. Physik,* 105. 7–8. *pp.* 495–500, 1937.—It is demonstrated that there exist relations between atomic nuclei, possibly of considerable theoretical importance, which depend only on the ratios of their magnetic moments and not at all on the mechanical moments or the absolute magnitudes of the magnetic moments. The ratio of the magnetic moments of two nuclei which differ in constitution by a pair of similar elementary particles is shown to be within one of a few definite numerical ranges which are obviously determined by the various possibilities of fitting a pair of particles into the nuclear particle complex. J. E. K.

3096. Structure and Non-Radiating States of Hydrogen and Helium Atoms. J. Stark. *Phys. Zeits.* 38. *pp.* 349–357, *May* 15, 1937. *From the Reichsanstalt.*—The spectral properties of the H and He atoms are discussed on the basis of a ring structure for the electron. C. B. A.

3097. Influence of Electrons on the Polarisation of Light Emitted from Canal Rays. J. Stark and H. Verleger. *Phys. Zeits.* 38. *pp.* 357–358, *May* 15, 1937. *From the Reichsanstalt.*—The polarisation of the light emitted from canal rays is shown to be decreased when electrons are removed from the canal ray beam by means of a strong electric field. C. B. A.

3098. Intensity Relationship of Moving and Stationary Lines of Hydrogen and Helium. J. Stark and H. Verleger. *Phys. Zeits.* 38. *pp.* 359–360, *May* 15, 1937.—The intensity distribution in a spectral series is shown to be affected considerably by motion of the emitting atoms, (*e.g.*, in canal rays). C. B. A.

3099. Series Law for Polarisation of Light Emitted by Canal Rays. J. Stark and H. Verleger. *Phys. Zeits.* 38. *pp.* 360–362, *May* 15, 1937.—It is shown for two spectral series of H and He respectively that the polarisation of the light emitted by canal rays decreases with the number of the line in the series. [See Abstract 4226 (1936).] C. B. A.

3100. Band Spectrum of Germanium Oxide. A. K. Sen Gupta. *Zeits. f. Physik*, 105. 7–8. *pp.* 487–494, 1937.—The band spectrum of germanium oxide between 2340 and 3300 Å has been studied spectrographically with an instrument of high dispersion and many new bands are recorded. The band system has been extended from $v' = 10$ to $v'' = 9$. The isotopic effect is considered. W. R. A.

3101. Infra-Red Absorption of Mixtures of Methyl Alcohol with Ethyl Formate and with Ethyl Acetate. D. Williams and W. Gordy. *Am. Chem. Soc., J.* 59. *pp.* 817–820, *May*, 1937.—Ethyl formate and ethyl acetate are found to shift the OH band of methyl alcohol to the shorter wave-lengths and to increase its intensity. The CO band of the esters is shifted to the longer wave-lengths by the alcohol, and its intensity is increased correspondingly. As a possible means of accounting for these results it is suggested that the esters may tend to decrease the polymerisation of the alcohol, and to become associated with it, to some degree, through the formation of weak H bonds. AUTHOR.

3102. Infra-Red Absorption Spectra of Alcohols, Two Acids, and their Solutions in CCl_4. E. L. Kinsey and J. W. Ellis. *J. Chem. Phys.* 5. *pp.* 399–405, *June*, 1937.—The paper describes the absorption spectra of the first eight alcohols of the aliphatic series and of formic and acetic acids in the regions extending from 0·9 to 2·3 μ and from 2·0 to 4·0 μ. The absorptions of the pure liquids are compared with their absorptions in CCl_4 solutions. For methyl and ethyl alcohols and the two acids comparisons are also made with their vapour spectra. In every case solution in CCl_4 modifies the bands characteristic of the OH group and leaves unchanged the hydrocarbon bands. The modifications are attributed to polymers or lattice structures which are partially destroyed in the solutions. Four bands near 0·96, 1·40, 1·89 and 2·1 μ for the alcohols and one near 1·40 μ for the acids which are present in the solution spectra are attributed to single molecules. Each of them in the solution spectra is accompanied by a broad almost continuous region of absorption on its long wave-length side, attributed to polymers, which grows stronger with increasing concentration until in the pure liquid it practically replaces the sharper bands predominating in the solution. The bands of the single molecules can still be detected, however, in each of the pure liquid alcohols. Comparisons is made with the spectrum of aniline whose behaviour near 1·4 μ is peculiar. AUTHORS.

3103. Near Infra-Red Absorption Spectrum of Cyanogen. D. Ştefănescu. *Soc. Roumaine Phys., Bull.* 38. 68. *pp.* 29–35, 1937. *In French.*—The author has studied the absorption spectrum of CN in the near infra-red. He has obtained absorption bands at 1·12, 1·35, 1·95 and 2·70 μ. The interpretation of these bands must be postponed until the complete study of the CN spectrum is achieved. Based on the results of Burmeister and the Raman frequencies, the author determines the fundamental frequencies of the CN molecule. AUTHOR.

3104. Schumann Region Absorption Spectra of SO_2 and H_2S. P. Herreng. *Rev. d'Optique,* 15. *pp.* 413–424, *Dec.,* 1936.—The absorption spectra of H_2S and SO_2 have been obtained between 2000 and 1200 Å, using a 1 m. vacuum grating with a fluorite window and a condenser discharge at 15,000 V through a 1 mm. pyrex capillary with an atmosphere of 0·1 mm. of H_2. H_2S bands between 1600 and 1200 Å are given. The SO_2 spectrum extends to 1500 Å. It was investigated without the window to 1100 Å, but the bands reported by Price between 1350 and 1000 Å were not observed. H. G. C.

3105. Ultra-Violet Spectral Properties of Salicylic Acid as Function of pH. Henriette Schuhler. *Comptes Rendus,* 204. *pp.* 1422–1424, *May* 10, 1937.—The effect of the pH of the solution on the intensity of the absorption band of salicylic acid at 3000 Å is studied, and the results are discussed from the viewpoint of dissociation of the phenol or the carboxyl groups. C. B. A.

3106. Absorption Spectrum of Nitrous Oxide in the Liquid State. B. Vodar. *Comptes Rendus,* 204. *pp.* 1324–1326, *May* 3, 1937. —The experimental technique is described and results for the extinction coefficients at − 82·5 and − 86·5° are given. From these it is concluded that the absorption varies with the temperature. W. R. A.

3107. Absorption Spectrum of Nitrous Oxide. B. Vodar. *Comptes Rendus,* 204. *pp.* 1467–1469, *May* 19, 1937.—The absorption has been measured quantitatively for the liquid for thicknesses from 2 cm. to 0·053 cm. The visible spectrum shows a minimum absorption at 4600 Å. Solutions of the other oxides have also been examined. F. S.

3108. Absorption Spectrum of Neodymium Acetylacetonate. Milka Radoïtchitch. *Comptes Rendus,* 204. *pp.* 1469–1470, *May* 19, 1937.—The absorption has been studied in, and found to depend upon, a large number of organic solvents. In some cases there is a regular displacement of the band system without change of structure or deformation and sometimes an irregular displacement with change of structure. The chemical constitution of the solvent plays a part, but neither dielectric constant nor electric moment suffices to explain the effects completely. F. S.

3109. Ultra-Violet Absorption Spectrum of Potassium Perrhenate. J. F. H. Custers. *Physica,* 4. *pp.* 426–429, *June,* 1937. *In English.*—The absorption spectrum of an aqueous solution of $KReO_4$ has been measured for various concentrations, in the region between 3134 and 2210 Å. The absorption becomes noticeable at about 3150 Å. A strong band is found at 2290 Å and a hardly pronounced one at 2390 Å. The absorption spectra of the MnO_4-ion and the ReO_4-ion are compared with each other. AUTHOR.

3110. Temperature Variation of U.V. Absorption Spectra of Acetone and Iodine in Solution. H. J. Walls and E. B. Ludlam. *Faraday Soc., Trans.* 33. *pp.* 776–781, *June,* 1937.—The absorption spectrum of acetone in solution in water, methyl alcohol, and hexane has been measured at various temperatures over a range of about 150° C. In all solvents the maximum of absorption shifts towards the red with increase of temperature. The shift is much less for water than for the other solvents; and in all the solvents the ratio, shift/(temperature difference), appears to increase with rise of temperature. These effects are briefly discussed. Iodine in ethyl alcohol shows a shift to shorter wave-lengths with rise of temperature. AUTHORS.

3111. Absorption Spectrum of Solid Oxygen in the Far Red. A. Prikhotko. *Phys. Zeits. d. Sowjetunion,* 11. 5. *pp.* 465–477, 1937. *In English.*—By slow cooling comparatively transparent crystals of the α-modification of O_2 and large homogeneous crystals of the γ-modification were obtained. The absorption spectra of γ, α and liquid O_2 have been photographed in the far red region of the spectrum. It has been shown that the absorption bands in the crystal are identical with the atmospheric bands of gaseous O_2, and are due to the same transitions $^3\Sigma_g^- \rightarrow {}^1\Delta_g$ and $^3\Sigma_g^- \rightarrow {}^1\Sigma_g^+$. In the spectrum of solid oxygen a complicated structure of the bands was observed which is absent in the gas and characteristic for the crystal. AUTHOR.

3112. Absorption and Fluorescence Spectra of Anthracene. A. A. Shishlovsky. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 1. *pp.* 29–33, 1937. *In English.*—A study is made of the absorption and fluorescence spectra of anthracene in different states of aggregation. Conclusions arrived at are (1) the absorption and fluorescence spectra of anthracene in varying states of aggregation closely resemble each other in appearance, (2) the spectra become displaced with regard to one another to the red on transition from vapour or solution to a solid state, (3) the fluorescence spectra from the vapours are much more blurred than are those from the solutions. A. H.

3113. Absorption and Fluorescence Spectra of Indium Vapour. R. Wajnkranc. *Zeits. f. Physik,* 105. 7–8. *p.* 516, 1937.—A correction. [See Abstract 1225 (1937).]

3114. Band Spectrum of Mercurous Iodide. T. S. Subbaraya, B. N. Rao and N. A. N. Rao. *Indian Acad. Sci., Proc.* 5A. *pp.* 365–371, *April,* 1937.—Details are given of the vibrational analysis of the HgI bands generally known as group III. It is found that these bands have no level in common with any of the other HgI systems that have been analysed. A. H.

3115. Band Spectrum of Cadmium Iodide. T. S. Subbaraya, N. A. N. Rao and B. N. Rao. *Indian Acad. Sci., Proc.* 5A. *pp.* 372–376, *April,* 1937.—A vibrational analysis is given for the group III CdI bands, and, as with HgI [see preceding Abstract], it is found that the bands have no level in common with any other system. Attention is drawn to a peculiarity in the manner in which the vibrational frequencies vary. A. H.

3116. Near U.V. $^1\Sigma\rightarrow{}^1\Sigma$ Band System of Gold Deuteride, and a New Analysis of Gold Hydride Spectrum. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 694. *pp.* 247–264, *May,* 1937. *In English.*—The Au arc in a D_2 atmosphere is photographed with 1·75 Å per mm. dispersion. 11 bands of the AuD $^1\Sigma\rightarrow{}^1\Sigma$ system, involving $v' = 0, 1, 2$, and $v'' = 0, 1, 2, 3$ levels are analysed in the region λλ 3370 – 4440. A new analysis of the corresponding AuH $^1\Sigma \rightarrow {}^1\Sigma$ system is made with the same accuracy, and molecular constants of the two emitters are compared. An electronic isotope shift of $21 \cdot 6$ cm^{-1} is found. From vibrational constants for normal $^1\Sigma$ states, a value of ρ is obtained, which is slightly larger than that required by the simple isotope theory. AUTHOR.

3117. Analysis of Molecular $^3\Pi$ States with Application to AlH, OH$^+$, and BH. C. N. Challacombe and G. M. Almy. *Phys. Rev.* 51. *pp.* 930–936, *June* 1, 1937.—The molecular constants λ, B, D for the $^3\Pi$ states of BH, AlH, and OH$^+$ have been calculated by the method of Gilbert, based on van Vleck's solution of the case of intermediate coupling, but including a more accurate consideration of the rotational D terms. A graphical method of obtaining λ has also been developed based on Budó's series expansion solution of the Hill and van Vleck energy equation for the intermediate $^3\Pi$ state. A graph shows, for a given K, the variation in multiplet splitting as the coupling constant λ is varied from – 8 to + 10. Graphs are plotted for K = 2, 3, 4, 5, and application is made to the $^3\Pi$ states of BH, AlH, OH$^+$ and NH. New data for AlH for lines with K less than 6 are given. A comparison of corresponding electronic *ls* coupling coefficients in molecule and atom is made. AUTHORS.

3118. Band Systems Ending on the 1*s*σ 2*s*σ $^1\Sigma_g$ (^1X_g) State of H_2. Part I. O. W. Richardson. *Roy. Soc., Proc.* 160*A*. *pp.* 487–507, *June* 15, 1937.—This paper deals mainly with an account of the first band system ending on the (lower)state 1*s*σ 2*s*σ $^1\Sigma_g$ (^{1}X) of the H_2 spectrum to be analysed. The systems ending on ^{1}X are of importance for a variety of reasons. They form the only missing link hitherto existing in the lower states of this spectrum. The final state is the deepest state which has been found up to the present to give transitions down to any state above the ground state of H_2 and is at present also the highest state to which transitions down, with emission of radiation, have been observed. The upper state is shown to be 1*s*σ 3*p*π $^1\Pi_a$ and the component 1*s*σ 3*p*π$^1\Pi_b$ is shown to be identical with Hopfield's D state. The structure of the upper state is given and its usual constants are deduced. The paper also contains an account of a progression of another state which goes down to the same end state. AUTHOR.

3119. Fundamental Frequencies of CH_2, CHD, CD_2, CHCl, CDCl, and Cis and *Trans* $C_2H_2D_2$ and $C_2H_2Cl_2$. Ta-You Wu. *J. Chem. Phys.* 5. *pp.* 392–398, *June*, 1937.—A valence force treatment of the groups CH_2, CHD, CD_2, CHCl, CDCl is given. The relative dependence of the three fundamental frequencies calculated for each group on the deformation force constant is used as a guide in correlating these frequencies with the three individual modes of vibration of the group. On the basis of this calculation, an assignment of the fundamental frequencies of *cis*, *trans* and asymmetric $C_2H_2D_2$ calculated by Manneback and Verleysen is given. Also from the data on the degrees of depolarisation of the Raman lines of *cis* $C_2H_2Cl_2$ and *trans* $C_2H_2Cl_2$, intensity and selection rules in Raman effect and infra-red absorption, an assignment of the fundamental frequencies of these isomers is suggested. AUTHOR.

3120. Energy States of Crystalline $Pr_2(SO_4)_3 \cdot 8H_2O$. F. H. Spedding, J. P. Howe and W. H. Keller. *J. Chem. Phys.* 5. *pp.* 416–429, *June*, 1937.—The absorption spectra of $Pr_2(SO_4)_3 \cdot 8H_2O$ were photographed when the salt was at 20°, 78°, 105°, 169°, 200°, and 300° K. At least three low lying excited levels were found to exist beside the basic one and they appear to be located at 110, 235 and 500 cm^{-1} above the basic state. They are therefore in fair agreement with the calculations of Penney and Schlapp [see Abstract 5262 (1932)], and with the field constant D for the rare earth sulphates which was determined spectroscopically for Nd and Er. A very strong coupling of vibrational states with the highly excited energy states seems to occur as the absorption bands consist of hundreds of closely spaced lines. [See following Abstract.] AUTHORS.

3121. Energy States in Solids, With Particular Reference to $NdCl_3 \cdot 6H_2O$. F. H. Spedding and H. F. Hamlin. *J. Chem. Phys.* 5. *pp.* 429–442, *June*, 1937.—The absorption spectra of $NdCl_3 \cdot 6H_2O$ were photographed at 78°, 169° and 200° K. Two low lying excited states were found, located at 62 and 250 cm^{-1} above the basic state. These three levels presumably arise from a splitting of the basic state of $Nd^{+++}(^4J_{9/2})$ in a predominantly cubic field. The over-all splitting is slightly smaller than that which was found for the sulphate, and the relative splitting is slightly different. The differences reflect the change in crystal field which is brought about by the break in the homologous series of the hydrated chlorides of the rare earths between Nd and Pr. [See preceding Abstract.] AUTHORS.

3122. Vibrational Spectrum of C_2H_6. J. B. Howard. *J. Chem. Phys.* 5. *pp.* 442–450, *June*, 1937.—The vibrations, frequencies and selection rules of C_2H_6, which is assumed to have an internal rotational degree of freedom subject to a restricting potential of an arbitrary magnitude, are investigated. Use is made of the fact that the total potential energy of such a molecule is invariant on reflection in a plane perpendicular to the threefold symmetry axis. The vibration selection rules are found to be the same for all degrees of restriction of the internal rotation except for the rules governing the appearance of degenerate frequencies in the Raman spectrum. Even in the limit of free rotation only one type of degenerate vibrational frequency is active in the infra-red spectrum. A normal coordinate treatment based on a three-constant potential function of the valence force type gives a set of frequencies in good agreement with the observed frequencies. The fundamental region of the vibrational spectrum affords no conclusive evidence for or against free internal rotation. [See following Abstract.] A. H.

3123. Rotation-Vibration Spectrum of C_2H_6. J. B. Howard. *J. Chem. Phys.* 5. *pp.* 451–459, *June*, 1937.—With free internal rotation in C_2H_6 the rotational structure of certain infra-red bands would be very different from that for a symmetrical top molecule without internal rotation. To account for the fact that this difference is not observed it is assumed that there is a potential difference of at least 2000 cal. (700 cm^{-1}) between the two symmetrical forms of C_2H_6 differing by an internal rotation of $2\pi/6$. This is based upon a dynamical treatment in which it is assumed that vibration, over-all rotation and internal rotation may occur simultaneously. The rotational selection rules are determined and it is found that under ordinary circumstances the internal rotation when free is inactive in the infra-red rotation-vibration spectrum. However, when there is accidental degeneracy of certain pairs of twofold degenerate vibrational levels, the internal rotation becomes active in the infra-red bands for these vibrations. It is concluded that C_2H_6 is an ordinary symmetrical top molecule without internal rotation. A. H.

3124. Vibrations of Asymmetrical Collinear Triatomic Molecules. Jenny E. Rosenthal. *J. Chem. Phys.* 5. *pp.* 465–466, *June*, 1937.—Expressions are derived for the vibration frequencies of asymmetrical collinear molecules of the X_2Y and XZY types. They are applied to the calculation of the frequencies of the N_2O^{18} molecule using an appropriate approximate potential function. The ratio of the distribution functions for N_2O^{16} and N_2O^{18} and the value of the equilibrium constant for the reaction $N_2O^{16} + H_2O^{18} \rightleftarrows N_2O^{18} + H_2O^{16}$ are also given. AUTHOR.

3125. Intensity Formulæ for Triplet Bands. A. Budó. *Zeits. f. Physik*, 105. 9–10. *pp.* 579–587, 1937.—The author gives explicit expressions for the intensity distribution in the branches of $^3\Sigma - {}^3\Pi$ and $^1\Sigma - {}^3\Pi$ bands holding for all values of the coupling constant Y of the $^3\Pi$ term. Corresponding formulæ may be deduced for $^3\Pi - {}^3\Pi$ bands. Intensity distributions calculated from the formulæ are compared with observed data for the $^3\Pi - {}^3\Sigma$ bands of PH and good quantitative agreement is found. L. A. W.

3126. Continuous Absorption Spectra of Polyatomic Molecules. Part VI. Y. Hukumoto. *Tohoku Univ., Sci. Reports*, 25. *pp.* 1162–1169, *March*, 1937. *In English.*—This paper continues the investigations of the continuous absorption spectra of the following polyatomic molecules:—(1) ethylen hydrins; (2) mercaptan derivatives; (3) benzyl derivatives; (4) benzyl derivatives of primary alcohols and other miscellaneous alcohols. The results obtained, together with some of the already available data, are discussed in the light of certain characteristic common configurations of molecules. [For Part V see Abstract 2579 (1935).] AUTHOR.

3127. Absorption Spectra and Dissociation Energies of Normal and *iso*-Thiocyanates. Sho-Chow Woo and T. C. Chu. *Chinese Chem. Soc., J.* 5. *pp.* 162–169, *May*, 1937. *In English.*—The absorption spectra of CH_3SCN, C_2H_5SCN, CH_3NCS, C_2H_5NCS, CH_2CHCH_2NCS and C_6H_5NCS in methyl alcohol solutions and in the gaseous state are investigated. For each of the substances, two continuous absorption regions are observed. In both of the continua, dissociation into alkyl or aryl and thiocyanate or *iso*-thiocyanate radicals is considered as the primary photochemical process. Approximate values for the dissociation energies are given. AUTHORS.

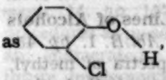
3128. Fluorescence Band Structure for Terbium Salt Solutions. N. Kremenewsky, J. Larionov and A. Seidel. *Acta Physicochimica*, 6. 4. *pp.* 481–486, 1937. *In English.*—The fluorescence spectra of aqueous solutions of Tb salts (mainly halides) reported upon earlier [see Abstract 3227 (1936)] are re-examined with somewhat higher dispersion. A. H.

3129. Stark Effect of Ionised Helium. Y. Ishida, S. Hiyama and H. Kubota. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers No.* 695. *pp.* 265–280, *May*, 1937. *In English.*—The Stark effect is measured of ionised He excited in lo-Surdo quartz tubes for the first, second and third members of the series, *i.e.*, λλ 4685, 3203 and 2733 Å respectively. The results are compared with the theoretical values calculated according to the wave mechanical theory of Schrödinger, and show a satisfactory agreement. It is also found that the theoretical values calculated by old quantum mechanics show a good agreement not only in displacements, which is expected *a priori* from the size of the factor Z, but also in intensities, so far as these measurements are concerned. AUTHORS.

3130. Raman Effect of Aqueous Solutions of Alkali Chlorides. F. Cennamo. *N. Cimento,* 14. *pp.* 64–69, *Feb.,* 1937.—The salts LiCl, NaCl, KCl, RbCl and $CaCl_2$ have, in equal molar concentration, almost identical effects on the Raman lines of water. R. P.

3131. Raman Effect of Furane Derivatives. K. Matsuno and K. Han. *Chem. Soc. Japan, Bull.* 12. *pp.* 155–163, *April,* 1937. *In English.*—The Raman spectra of methyl and ethyl esters of α-furfuracrylic acid, cinnamic acid, α-furylpropionic acid, and hydrocinnamic acid are measured. On comparing the Raman spectra of α-furfuracrylates with those of *trans*-cinnamates and other cinnamic compounds, the so-called stable furfuracrylates are considered as the *trans*-esters. AUTHORS.

3132. Raman Spectra of Amino-Acids and Related Compounds. Part III. J. T. Edsall. *J. Chem. Phys.* 5. *pp.* 225–237, *April,* 1937.—Raman spectra are reported for the methylated amines and for the corresponding ammonium chlorides in water, also for ethylamine and its hydrochloride, and for the hydrochlorides of hydroxylamine, hydrazine, and trimethylamine oxide. The spectrum of a methylated NH_4-ion is found to be similar to that of the analogous hydrocarbon in which a C atom is substituted for the positively charged N atom. All the compounds can be represented by simple models, by taking the CH_3 and NH_3 groups as single atoms of the same mass. The characteristic frequencies of such models are correlated with lines in the observed spectra. Qualitative polarisation measurements have been made and these observations have helped in the allocation of spectra. Bond force-constants and valence angles are evaluated. The valence vibrations of the uncharged amine group between 3300 and 3400 $cm.^{-1}$ are absent in the charged $-NH_3^+$ or NH_2^+ group. Evidence is given that the amino-acids exist as electrically charged dipolar ions, $^+H_3N\cdot R\cdot COO^-$. [For Part II, see Abstract 1889 (1937)]. A. C. M.

3133. Raman Effect and Dipole Moment in Relation to Free Rotation. Part VI. K. Kozima and S. Mizushima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 697. *pp.* 296–310, *May,* 1937. *In English.*—The scarcity of lines in the Raman spectrum and the absence of a dipole moment in 1,1,2,2- tetrachloro- 1,2-dibromoethane indicate that it exists in the *trans* form. *o*-Chlorophenol is found to exist principally as 

, in fact to an extent much greater than is to be expected from the observed intensity ratio on the assumption of the same transition probability. 1,1,2,2-tetrabromoethane, hexachloroethane and *o*-xylylene dibromide are also considered. [For Part V see Abstract 4739 (1936).] W. R. A.

3134. Raman Spectra of Complex Ions of the Type MeA_6. Werner's Complexes. J. P. Mathieu. *J. de Physique et le Radium,* 8. *pp.* 169–174, *May,* 1937.—In continuation of previous work [see Abstract 2660 (1937)] the Raman spectra of ions of the indicated type are studied. The structure of these ions has a very simple symmetry and therefore the Raman lines form a simple pattern, particularly in the chemically stable compounds. The number and polarisation of these lines is compared with theoretical predictions. R. P.

3135. Raman Spectra of Monomethoxy Derivatives of Ethyl Benzoate. Dorothy D. Thompson. *Am. Chem. Soc., J.* 59. *pp.* 816–817, *May*, 1937.—The Raman spectra of pure methoxy derivatives of ethyl benzoate are determined and compared with the spectra of other derivatives of ethyl benzoate and of benzoyl chloride. The boiling points, densities, indices of refraction and molecular refractions for these compounds are also determined and recorded. AUTHOR.

3136. Raman Spectra of Deuteroparaldehyde and Paraldehyde. R. W. Wood. *J. Chem. Phys.* 5. *pp.* 287–289, *May*, 1937.—Improved technique is described for observations of Raman spectra in liquids, and it is applied to deuteroparaldehyde (1 c.c.) and paraldehyde. The former is observed for the first time, and the frequencies of the lines got for the latter substance are discussed in connection with the results of earlier observations. A. C. M.

3137. Raman Spectra of Acid Chlorides. V. N. Thatte and M. S. Joglekar. *Phil. Mag.* 23. *pp.* 1067–1078, *June*, 1937.—Eleven acid chlorides are examined using a Hg arc filtered through $NaNO_2$ as source. All the compounds give lines at about 1790 $cm.^{-1}$ ($C = O$) and 448 $cm.^{-1}$ ($C - Cl$). Lines at 664, 548 and 347 occur less regularly. H. G. C.

3138. Vibrations of Five-Membered Ring Compounds. Model Experiments. A. W. Reitz. *Zeits. f. phys. Chem.* 35. *Abt.B.*5. *pp.* 363–381, 1937.—In the first part of this work [see Abstract 4744 (1936)] the symmetry properties of a five-membered ring compound (*e.g.*, cyclopentane) were discussed. This part reports the results of work on 17 models of cyclopentane, cyclopentene, cyclopentadiene, and related substances. Determinations of frequencies were carried out, and as far as possible compared with the experimental data. An attempt was made to trace corresponding frequencies from model to model, in order to evolve a basis for the analysis of the spectra of similarly built molecules. One conclusion can already be drawn: as one goes from cyclopentene to cyclopentadiene (or to pyrrhol, furane, or thiophene) the frequency 1600 $cm.^{-1}$ characteristic of the C : C link disappears, and a very strong line appears in the region 1400–1500 $cm.^{-1}$. The model experiments do not explain this lowering of frequency. It is concluded either that these substances do not contain the double link, or that some factor such as strain in the ring is responsible. A. C. M.

3139. Influence of Perchlorates on the Raman Lines of Alcohols and Acetone. J. Goubeau. *Zeits. f. phys. Chem.* 36. *Abt.B.* 1. *pp.* 45–84, 1937.—The effects are observed on the Raman spectra of methyl, ethyl, *n*-propyl, and *n*-butyl alcohol, acetone, ethylacetate, diethyl ether, when different metal perchlorates are dissolved in them. Conversely the effect is observed on the perchlorate ion lines of dissolving the salts in the solvents. Slight shifts (of the order of 5–10 $cm.^{-1}$) are observed. The behaviour of the line 1050 $cm.^{-1}$ in the alcohols, suggests that it belongs to a vibration of the OH-ion with respect to its neighbouring CH_2 group. The vibrations of the alcohol molecules are discussed. The action of the intramolecular forces can be explained as an influence of dipoles and ions on the negative O atoms. The induction-effect is great in the case of an α-type methyl group, and it decreases greatly with the length of the chain, so that the β-methyl groups have hardly any effect. It is suggested that from the shifts of the Raman lines may be calculated the infra-red term, necessary for the precise calculation of dipole-moments. A. C. M.

3140. Raman Spectra of Crystal Powders. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 5A. *pp.* 200–221, *March*, 1937.—Using the crystal powder method, modified by the use of complementary filters, the Raman spectra are observed for the following :—Naphthalene, oxalic acid, urea, guanidine hydrochloride, acetamide, propionamide, amino-acetic acid, phenyl acetic acid, phosphorous acid, sodium phosphite, phosphoric acid, and boric acid. Some of the particular frequencies recorded are discussed, and their origins suggested. [See Abstract 1701 (1937).] A. C. M.

3141. Raman Spectra of Mixed Crystals. M. Vuks. *Acta Physicochimica*, 6. 3. *pp.* 327–338, 1937. *In German.*—The Raman spectra of mixed crystals of *p*-dibrombenzene and *p*-dichlorbenzene are investigated over a range of compositions. It is found that in the larger frequencies (designated as molecular frequencies) the observed spectra are always a simple superposition of the spectra of the individual components, but that in the smaller frequencies ($\Delta\nu = 20$ to 93 cm^{-1}, designated as lattice structure frequencies) there is a gradual transition from the spectrum of the one component to that of the other. L. A. W.

***3142. Hydrogen Tube.** *Rev. d'Optique*, 16. *pp.* 28–33, *Jan.*, 1937.—Details are given of a powerful hydrogen tube suitable for producing a continuous u.v. spectrum. The gas is at a pressure of 2 mm. of Hg and the discharge takes place in a tube 1 m. long and a few mm. in dia. The tube takes from 3 to 6·5 A at 3000 V. A. H.

***3143. Method for Sealing β-Magnesia Windows into Steel Spectroscopic Absorption Furnaces and a Needle Valve for Controlling the Evacuation of Such Furnaces. R. T. Brice.** *Rev. Sci. Instruments*, 8. *pp.* 209–212, *June*, 1937.—A method is described whereby β-magnesia windows may be sealed into heavy steel tubes, thus making them suitable for vacuum furnaces. These seals, utilising Cu or Al bands around the edges of the windows, have been made and tested up to 587° C. without leaking. A needle valve is designed which permits the opening or closing of an evacuation port in the side of a vacuum furnace at will. This valve operates at the temperature of the furnace and does not introduce a cold spot into the absorption chamber. It has been tested up to 587° C. and holds well against pressure differences of one atmosphere. Being made of stainless steel, it is relatively inert and is free from oxidation scale. AUTHOR.

3144. Spectroscopy in Industry. A. Fowler. *Journ. Sci. Instruments*, 14. *pp.* 153–161, *May*, 1937.—In this address the principles and procedures at present in use for both qualitative and quantitative analysis are enumerated. A number of applications are described and some future developments forecast. F. S.

3145. Total Radiation of High-Pressure Mercury Discharge. W. Elenbaas. *Physica*, 4. *pp.* 413–417, *June*, 1937. *In German.*—The total radiation S of the high-pressure Hg discharge is measured for diameters 3·3, 9·2, and 27 mm. at different pressures (0·1—25 atmos.) and inputs per cm. of length L (8—75 W/cm). For $L > 20$ W/cm and the pressure greater than $10/d$ atmos. (d = dia. in mm.), the total radiation of the discharge can be written as $S = 0{\cdot}72\ (L - 10)$ W/cm. AUTHOR.

See also Abstracts 2883, 2890, 2891, 2969, 3052, 3066, 3178.

VELOCITY OF LIGHT.

See Abstract 2892.

VISION.

3146. Representation of Colour Sensations in a Colour Space-Diagram or Colour Triangle. P. J. Bouma. *Philips Techn. Rev.* 2. *pp.* 39–46, *Feb.*, 1937.—On the basis of the experimental results obtained on colour mixing, it is demonstrated how all colour sensations can be represented in a colour space-diagram and how various transformations can be applied to this space-diagram. In many cases such a space-diagram can be replaced by a suitable colour triangle. Various characteristics of these triangles, particularly the I.C.I. 1931 standard triangles are discussed, and a series of formulæ are given for the computation of colour mixtures. [See also Abstract 737 (1937).] AUTHOR.

X-RAYS.

***3147. Grid Action X-Ray Tubes. S. W. West.** *Radiography*, 3. *pp.* 51–55, *April*, 1937.—In an X-ray tube of the hot-kathode type, the tube current is saturated for most of the voltage cycle and consequently a large virtually ineffective current passes through the tube at the lower tensions of a pulsating voltage supply. This ineffective current may be reduced by shielding the kathode in a recess so that current only passes when the voltage is near its maximum value. A similar effect may be produced by providing a negatively charged grid between the filament and the anode, but usually this restricts the current unduly. This latter defect may be overcome by giving the grid a bias which fluctuates with the tube voltage. G. E. B.

3148. Geiger-Müller Counter Measurements of Reflected Mo Kα X-Rays from Powdered Zinc. R. D. Miller. *Phys. Rev.* 51. *pp.* 959–963, *June* 1, 1937.—Volz has used the formula $n = n_0 \exp(-n_0/2.78n_m)$ where n is the observed counting rate of the system, n_0 is the rate of production of pulses in the counter and n_m is the maximum possible random counting rate. It was found that n_0, calculated from n and corrected for background count, varied as the inverse square of the distance from a γ-ray source. Further, the absorption coefficient of Mo Kα rays in Al was found to have the correct value when measured by means of this formula. Thus the formula was satisfactory. The absolute F values were obtained by comparison of the $(11\bar{2}2)$ reflection from zinc with the (420) reflection from KCl. This gives $F(11\bar{2}2) = 13{\cdot}9$. Brindley, using Cu Kα rays, obtains $F(11\bar{2}2) = 12{\cdot}0$. The difference is caused by dispersion. The F values for other reflections very closely agree with those found by Brindley for Cu Kα rays, when his values are corrected for dispersion. The very weak (0004) reflection, which was not obtained by Brindley, was found to have an F value of about 10·6. Jauncey and Bruce's values of the amplitudes of the thermal vibrations parallel and perpendicular to the *c* axis fit these results better than do Brindley's. AUTHOR.

3149. Soft X-Ray Photometry and Conduction Electrons in Metals. J. Farineau. *Comptes Rendus*, 204. *pp.* 1242–1244, *April* 26, 1937.—The K- and L-spectra of Al and Mg have already been investigated [see Abstracts 5181 (1936) and 2685 (1937)]. For this work X-ray films or Schumann plates were used. The latter are particularly unsatisfactory for photometric work as their sensitivity varies considerably with time, two plates are never absolutely identical and sometimes the sensitivity varies between two regions on the same plate. Such plates have been studied and from this work the distribution of intensity in the $K\beta_2$ rays of Al and Mg is determined and compared with the theoretical values calculated on the free electron hypothesis. The concordance of theory and experiment is very good in the case of Mg, but for Al is unsatisfactory. The M electrons of Mg are therefore practically in a free state, but for Al are more tightly bound in the crystal lattice. C. J. B. C.

3150. K-Radiation of Boron. A. Hautot and J. Serpe. *J. de Physique et le Radium*, 8. *pp.* 175–178, *May*, 1937.—A study is made of the K radiation from B in the crystalline and amorphous form, and also from two compounds containing this element. The structure of the K-radiation varies quite markedly with the temperature ; the compounds show a quite different structure from that of the element. The experimental results may be satisfactorily explained on the basis of the Fermi statistics and from a consideration of the propagation of electric waves in a crystal. The results indicate that at low temperatures the conductance electrons are strongly bound in the crystal, while at higher they may be considered as free electrons, in agreement with conductance data. In contrast with the element, the compounds of B limit K-radiation composed of several well separated constituents. The low conductivity of boric anhydride and borax is to be ascribed to fact that the electrons are strongly bound to the ions in the crystal, rather than to an absence of conduction electrons. C. J. B. C.

3151. Moseley Diagram of X-Ray Term Values. D. Coster. *Physica*, 4. *pp.* 418–425, *June*, 1937. *In English.*—The Moseley curves of the X-ray term values are brought up to date. The slopes of these curves are tabulated for different regions of the periodic system and some peculiarities connected with the change of the slope of the curves are discussed. AUTHOR.

3152. Radiation Probabilities, Auger Effect and Energy Level Widths for Au (79). E. G. Ramberg and F. K. Richtmyer. *Phys. Rev.* 51. *pp.* 913–925, *June* 1, 1937.—The theory of energy level widths developed by Weisskopf and Wigner and by Wentzel is applied to the calculation of the energy level widths of Au(79). Radiation and Auger transition probabilities are determined separately with the aid of numerically integrated nonrelativistic eigenfunctions, the latter being calculated for electrons moving in the Fermi-Thomas field of $Tl(81)^{++}$. Sources of error are considered, the major one being the nonrelativistic treatment. The band width due to the interaction of electrons in different atoms in the crystal lattice does not add materially to the level width of the O_1 and lower states. Except for the K state, the Auger contribution to the width exceeds that of the radiation transitions. Where the majority of the significant Auger effects have been calculated (L_1, M_1, N_1) the total calculated width is found to be appreciably in excess of the observed width, but of the same order. The results confirm the view that the contributions of radiation transitions and Auger effects to the level widths of the initial and final states of the atom suffice to explain the magnitude of the widths of the X-ray lines emitted by the heavy elements. AUTHORS.

3153. Satellite Structure of $L\alpha$ and $L\beta_2$ of Au(79). F. K. Richtmyer and E. G. Ramberg. *Phys. Rev.* 51. *pp.* 925–929, *June* 1, 1937.—Assuming the correctness of Coster and Kronig's hypothesis [see Abstract 1693 (1935)] of the origin of the satellites accompanying $L\alpha$ and $L\beta_2$, the separations and relative intensities of these satellites are calculated for Au(79) by means of the theory of complex spectra. Making use of data on the mean life of the states involved in the transitions and on the probability of the Auger effect producing the initial state for the satellite emission, contours of the satellite structure are obtained and compared with patterns previously measured with the two-crystal spectrometer. Within the limitations of the theoretical treatment as well as the experimental material the agreement, both with regard to intensity distribution and relative intensity of parent lines and satellites, is satisfactory and confirms Coster and Kronig's theory. AUTHORS.

3154. Theory of Fine Structure in X-Ray Absorption Spectra of Triatomic Molecules. B. W. Bogdanovich. *Phys. Zeits. d. Sowjetunion,* 11. 5. *pp.* 513–525, 1937. *In English.*—An exact formula for the fine structure of X-ray absorption spectra of triatomic molecules is given. The scattering of the electron wave by a system of two atoms is investigated. It is shown that the assumption that the molecule possesses axial symmetry hardly changes the fine structure function. [See also Abstract 2151 (1937).] AUTHOR.

3155. Fine Structure of Laue X-Ray Pattern Obtained by the Method of Convergent X-Rays. T. Fujiwara. *Hirosima Journ. Sci.* 7. *pp.* 179–182, *March,* 1937.—The fine structure of the Laue X-ray pattern obtained with a fine single crystal wire by using the method of convergent X-rays is examined minutely. AUTHOR.

3156. Measurement of Extra Hard X-Rays and γ-Rays in Roentgens. G. C. Laurence. *Canad. J. of Research,* 15. *Sect. A. pp.* 67–78, *May,* 1937.—The intensity in roentgens per sec. of X-rays or γ-rays harder than 0·03 Å may be measured with a small thimble chamber with homogeneous walls of elements below atomic number 13 and thick enough to be impermeable to the fastest secondary β-rays. The ionisation current measured under saturation conditions at standard temperature and pressure is divided by BV, and correction is made for the apparent absorption of the X-rays in the walls. V is the volume of the chamber and B is given by $B = 1 + 2 \log_e(Z_w/Z_a)\ J/L + [2 \log_e (Z_w/Z_a)]^2\ K/L + \ldots$ A table of the values of $2 \log_e (Z_w/Z_a)$ for different wall materials is given, and J, K, and L are plotted as functions of the quality of the radiation. The absolute intensity of radiation in quanta /cm²./sec. may be obtained from $c = BL \times 2{\cdot}92 \times 10^{15}$ e.s.u. per cc., in which c is the ionisation current per unit volume in the chamber, at standard temperature and pressure, produced by one quantum /cm²./sec. The intensity of the radiation from 1 mg. of Ra in equilibrium, and covered by Pt of wall thickness t, at 1 cm. distance is $(8{\cdot}9_8 - 1{\cdot}7_7\ \text{mm.}^{-1} \times t)$ roentgens per hr. approximately, if t is not less than 0·3 mm. AUTHOR.

See also Abstracts 2889, 2900, 2916, 2923, 2925, 3277.

HEAT.

CALORIMETRY.

3157. Heat Content of Water Sorbed on Cellulose. J. H. Shipley, W. B. Campbell and O. Maass. *Canad. J. of Research,* 15. *Sect.A. pp.* 224–228, *May,* 1937.—The specific heat of cellulose has been determined for the temperature range − 70° to 25° C. The heat capacity of water sorbed to the extent of 5·92 and 12·0 % by cellulose has been determined for the range − 78·5° to 25° C. These data are compared with the heat capacity of pure water for the same range of temperature, *viz.*, − 78·5° to 25° C. AUTHORS.

3158. Heat Capacity of Silver Nitrite. O. L. I. Brown, W. V. Smith and W. M. Latimer. *Am. Chem. Soc., J.* 59. *pp.* 921–924, *May,* 1937.—The heat capacity of $AgNO_2$ is determined from 15 to 300° K. The entropy is calculated at 298·1° K. The entropy of nitrite ion is determined as 29·0 e.u. The entropy of nitrate ion is calculated by four independent methods and the values 35·2, 35·0, 34·7 and 35·0 e.u. are obtained. The entropy of thallous ion is calculated by two independent methods and the values 30·7 and 30·1 e.u. are obtained. The heats of solution of silver nitrite, barium nitrate and thallous nitrate at 298·1° K. are determined. The free energy of formation of nitrate ion at 298·1° K. is calculated to be − 26,310 cal. AUTHORS.

3159. Specific Heat, Enthalpy and Entropy of Air. E. Justi. *Ann. d. Physik,* 29. 3–4. *pp.* 302–305, *June,* 1937.—Values for the specific heat at constant pressure, C_p, the entropy difference ΔS_t, and the mean specific heat at constant pressure, $\bar{C}_p$, between 0° and t° C, derived from spectroscopic and thermodynamic data, are tabulated for dry air at intervals of 100° C. between − 100° C. and 2000° C. Values are given in cal./mol./deg. and cal./gm./deg. The effect of pressures between 0 and 1 atmosphere upon values of C_p are, in general, negligible; the same is true of the pressure correction relating to entropy. An expression is derived for the variation of enthalpy with pressure. J. S. G. T.

3160. Effect of Thermal Treatment on the Molar Heat of Condensed N_2O. A. Eucken and H. Veith. *Zeits. f. phys. Chem.* 35. *Abt.B.* 6. *pp.* 463–466, 1937.—Experiments on the effect of previous heat treatment on the value of C_p and the latent heat of fusion of solidified N_2O are very briefly described. The liquid was held at various temperatures for differing periods before solidification and subsequently the variation of the latent heat with temperature over a short range in the neighbourhood of the triple point was measured. It is shown graphically that such heat treatments have practically no effect on the variation of C_p with temperature. It appears therefore that neither by slow crystallisation nor by annealing at a lower temperature can the value of the thermal entropy be perceptibly influenced. E. H. D.

See also Abstracts 3181, 3218.

CONDUCTION.

3161. Laws of Heat Conduction in Metals. G. Borelius. *Ann. d. Physik,* 29. 3–4. *pp.* 251–255, *June,* 1937.—Equations relating to the thermal conductivity of metals at low temperatures, which were previously suggested by the author, are now discussed in the light of subsequent experimental results of Grüneisen and Reddemann [see Abstract 5191 (1934)] and Bremmer and de Haas [see Abstracts 3731–3733 (1936)]. In accordance with these predictions the results of the latter workers for Hg and Pb at very low temperatures tend to give values of the product T *w* (temperature thermal resistivity), which are independent of T, but the value depends on whether or not the metal is in the supraconducting state. Using Grüneisen and Reddemann's results for Ag-Au alloys and the Au rich Au-Pd alloys, the thermal conductivity contribution of the crystal lattice is derived, and the results indicate probable values of 0·1 and 0·05 watt/cm./° C. at − 251° C. and − 190° C. for the lattice conductivity of pure Au. Need is expressed for additional results covering a wider range of compositions. R. W. P.

3162. Effect of Transverse Magnetic Field on Thermal Conductivity of Metals. M. Kohler. *Ann. d. Physik*, 29. 3–4. *pp.* 250–263, *June*, 1937.—The change of thermal conductivity of a metal produced by means of a transverse magnetic field (H) at high temperature (T) is investigated on the basis of electronic theory, it being assumed that there is an anisotropic time of impact, although the distribution of the eigenvalue is isotropic, as assumed in Sommerfeld's treatment. The theory shows that weak magnetic fields should produce a decrease in the thermal conductivity which is directly proportional to H^2 and inversely proportional to T^2. With strong fields the thermal conductivity should decrease to a limiting value. The Wiedemann-Franz law should be obeyed at all field strengths. R. W. P.

3163. Conduction of Heat by Gases at High Temperatures. K. H. Riewe and R. Rompe. *Zeits. f. Physik*, 105. 7–8. *pp.* 478–486, 1937. —By means of applications and developments of the diffusion theory of Nernst the portions of the effective conduction of heat which are produced by the transport of kinetic, of dissociation, and of ionisation energy are calculated afresh. The chief substances dealt with are H_2, O_2, Na, He, Hg, and the results of the calculations are exhibited graphically. J. J. S.

3164. Heat Flow in an Infinite Solid Bounded Internally by a Cylinder. L. P. Smith. *J. of Applied Physics*, 8. *pp.* 441–448, *June*, 1937. —The problem of the flow of heat through a long tunnel wall in an infinite solid is treated and the results for the rate of flow and total heat flow are expressed in a convenient form for numerical computations. This general problem has become of interest in connection with the cooling of deep mines. AUTHOR.

3165. Thermal Conductivity of Artificial Materials. S. Erk, A. Keller and H. Poltz. *Phys. Zeits.* 38. *pp.* 394–402, *June* 1, 1937.— Apparatus for the determination of the thermal conductivity of thin plates of artificial materials by comparison with that of a boron crown glass plate is described. Results relating to the densities and thermal conductivities of 46 materials, including compressed paper, compressed micanite and various synthetic resins at mean temperatures of about 40° C. are tabulated. The thermal conductivity of compressed materials increases with increase of density. Phenolic and urea resins, whether containing filling material or not, have all about the same thermal conductivity, *viz.*, 0·27 ± 0·06 k.cal./m. hr. °C. J. S. G. T.

See also Abstracts 2881, 2928.

CONVECTION.

3166. Band Eddies in Liquids. V. Volkoviski. *Comptes Rendus*, 204. *pp.* 1461–1463, *May* 19, 1937.—The generation and stability of band eddies in a plane stream of liquid, of depth *h*, are investigated very briefly both theoretically and practically. The dependence of λ/h upon viscosity and thermal diffusibility are referred to, and it is pointed out that at a velocity of flow of the liquid below a certain critical value, the band eddies are transformed into cellular eddies. The effects of an obstacle and temperature gradient on band eddies in air have been discussed by Avsec and variations of depth of liquid are illustrated [see Abstract 1273 (1937)]. J. S. G. T.

∗3167. Emissivity of Sheet Materials. P. F. McDermott. *Rev. Sci. Instruments*, 8. *pp.* 185–192, *June*, 1937.—A description is given of an apparatus for measuring the total normal thermal emissivity of sheet materials up to [illegible] inches in thickness at temperatures from 140 to 500° F. without contact or damage to the surfaces viewed. An analysis of possible errors is made which shows the outer limits of absolute values to be within ± 1% of black-body emission. A table of emissivities as measured is given with values from the literature included for comparison. By minimising errors due to reflection, the values for poor emitters are found to be somewhat lower than those usually reported and are held to be more accurate. AUTHOR.

See also Abstract 3173.

DILATATION.

See Abstracts 2904, 3181.

MELTING AND BOILING POINTS.

3168. Melting Point Diagrams of Binary Systems of Condensed Gases. H. Veith and E. Schröder. *Zeits. f. phys. Chem.* 179. *Abt. A.* 1. *pp.* 16–22, 1937.—By observation of warming curves, using an internally heated vacuum calorimeter, melting point diagrams are obtained for the systems Kr–CH_4, A–CH_4, A–Kr and A–O_2. The first three of these show unbroken ranges of mixed crystal formation, the system A–CH_4 having a deep minimum and giving separation of the components in the solid phase at high concentrations of A. In the system A–O_2 the range of mixed crystal formation is broken from 79 to 90 mol. per cent. of O_2. The mixture with 90 mol.% of O_2 is a peritectic melting unchanged at 55·8° Abs. L. A. W.

3169. Interaction of Vapour Molecules with a Crystal Surface. T. Alty. *Roy. Soc., Proc.* 161 *A.* *pp.* 68–79, *July* 1, 1937.—Information regarding the interchange of molecules between a subliming crystal and its vapour is obtainable from a knowledge of the rate of sublimation of the crystal into a vacuum. In this paper, measurements of the rates of sublimation of crystals of iodine, naphthalene, synthetic camphor, and benzoic acid are described, and the coefficient of condensation for the vapour molecules on the crystal surface is deduced for each. The results indicate that, in the case of iodine and naphthalene, the value of the coefficient is near to unity, but for camphor its value is 0·17 and for benzoic acid it is probably smaller than 0·1. AUTHOR.

***3170. Design and Analysis of Fractionating Columns for Complex Mixtures. P. Docksey.** *Inst. Petroleum Technologists, J.* **23.** *pp.* **316–349,** *May,* **1937.**

See also Abstracts 2929, 3135.

TEMPERATURE, MEASUREMENT OF.

***3171. Resistance Thermometry below 1° K. J. F. Allen and E. S. Shire.** *Nature,* 139. *pp.* 878–879, *May* 22, 1937.—Resistance-temperature curves have been obtained by the authors for a phosphor-bronze resistance thermometer down to a susceptibility temperature of 0·027°. The results show that a phosphor-bronze resistance thermometer can be conveniently used in the range of temperature below 1° K. From Simon's relation the probable difference between susceptibility temperature and the absolute temperature at such very low temperatures is not greater than 0·02°.

***3172. Three-Element Thermocouple for Precision Temperature Measurements. M. Tanaka and K. Okada.** *Electrot. Laborat. Tokyo, Japan, Researches No.* 404, [82 *pp*]., 1937. *In English.*—In this paper the error of a thermocouple due to thermal conduction along the element wires, insulation tubes, etc., is discussed, and a new three-element thermocouple, the error of which can be corrected or compensated, is described, together with the experimental procedure for constructing three-element thermocouples and the determination of their temperature scales. It is found that the error due to thermal conduction is by no means negligible if the depth of immersion is insufficient, and that the equilibrium temperatures at the melting and freezing points of a metal coincide if the error is corrected for thermal conduction. AUTHORS.

3173. Determination of Surface Temperature of a Thermal Insulator in a Very Rapid Stream of Incompressible Fluid. G. Kroujiline. *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 73–77, 1937. *In English.*—The problem considered is one of practical importance in the measurement of fluid temperature by means of a thermometer or thermocouple immersed in the fluid stream. Calculation is made of the equilibrium temperature attained by a thermal insulator which is warmed by surface friction with a plane parallel stream of rapidly moving incompressible viscous fluid. In the general case this temperature is shown to depend on the coordinates of the point considered and not on the dimensions of the body or Reynolds number. For longitudinal flow over a plane surface it is shown that the increase in temperature is given by $(A/\gamma c)\rho U_0^2/2$, where γ, c, and ρ are the specific weight, heat capacity and density of the fluid, U_0 its velocity and A the thermal equivalent. R. W. P.

See also Abstracts 2991, 3090.

THERMOCHEMISTRY.

3174. Heats of Hydration and Saturation of Sodium Sulphate. J. Perreu. *Comptes Rendus,* 204. *pp.* 1330–1332, *May* 3, 1937.—Kirchhoff's equation $Q_s = [T^2(1 - sC)d\log(p/P)]/503CdT$, where Q_s is the heat of saturation of the hydrate $S \cdot sH_2O$, T the absolute temperature, C the concentration of the saturated solution, P, p the vapour pressures of H_2O and of this solution respectively; and also the equation

$X^{s_1}_{s_2} = [T^2(S_1 - s_2)d\log(p/P)]/503dT$, where $X^{s_1}_{s_2}$ is the heat of hydration of the hydrate $S \cdot s_2H_2O$ to $S \cdot s_1H_2O$, are shown experimentally to apply to $Na_2SO_4 \cdot nH_2O$, for $n = s_1 = 10$, and $= s_2 = 0$. C. A. S.

3175. Heats of Solution of HCl and HBr. W. A. Roth and A. Bertram. *Zeits. f. Elektrochem.* 43. *pp.* 376–378, *June*, 1937.—Values obtained do not satisfy the formula $Q_m = a - b\sqrt{m}$ found by previous workers. The plot of Q_m against $\sqrt{m}$ shows for HBr a very flat, and for HCl a rounded peak. From the curves Q_∞ is estimated to be 17·45–17·50 for HCl and 16·00 for HBr. D. R. H.

3176. Speed of Flame Propagation in Gases. L. Khitrin. *Techn. Phys., U.S.S.R.* 4. 2. *pp.* 110–120, 1937. *In English.*—The speed of uniform flame movement is not of itself a value characteristic of the normal speed of propagation, which it is desired to find; it is a value proportional to the general quantity of the mixture ignited in unit time, and depends on the dimensions of the flame surface, and on the conditions of propagation. Seen from this point of view, the value of the speed of uniform movement is of great practical importance. The value of the normal speed of inflammation should always be determined as the ratio of the volume of fuel mixture consumed in unit time, to the area of the surface of inflammation. This is a result of "Gouy's postulate," and a consequence of the nature of normal combustion. In view of this there is no necessity for the new term "fundamental speed" proposed by Coward and Hartwell. The tube method permits of sufficiently accurate determination of the value of the normal speed, but to achieve this it is necessary to record the shape and dimensions of the flame surface which correspond to the stage of uniform movement. The value of the speed of uniform movement may in general serve as a relative characteristic of the process of propagation in cases where the external physical conditions remain unchanged. In any other case, possible changes in the dimensions of the flame surface may lead to incorrect results. AUTHOR.

3177. Theory of Bunsen Flames. L. Khitrin. *Techn. Phys., U.S.S.R.* 4. 2. *pp.* 121–137, 1937. *In English.*—It is shown that the form of the internal "cone" of a bunsen flame may be theoretically explained in a considerably more simple manner, and with greater physical reality, than was done by Michelson. The resulting expression for the equation of the surface of ignition, may be written in the form: $z = a(R-r) - b(R^2-r^2)$, where a and b are constants depending on the dimensions of the burner, and on the rate of gas flow. According to the theory advanced, the really steady part of the ignition surface is the lower ring part of the "cone," where direct compensation of the flame speed by the opposing movement of the gas occurs. This steadiness of the ring zone plays the part of a continuously acting ring of ignition, and plays a very essential rôle from the practical point of view. The equations deduced for the form of the ignition surface allow of a simple and relatively accurate calculation of the height of the bunsen "cone," and the dimensions of its lateral surface. Certain further peculiarities of the form of the internal "cone" are established. These peculiarities may be explained from the point of view of the finite thickness of the zone of noticeable heating of the gas contiguous with the surface of ignition. The character of the change of this widening with concentration and pressure is in good agreement with the theoretical formula which was determined for the zone of heating. AUTHOR.

3178. Radical OH in Hydrogen Flames at Low Pressures. V. Kondratjew and M. Ziskin. *Acta Physicochimica*, 6. 3. *pp.* 307–319, 1937. *In English.*—Absorption of light by OH radicals has been found in the combustion zone of H_2 burning in O_2 at furnace temperatures from 470 to 550° C. and pressures from 3 to 25 mm. The temperature calculated from the measured absorption coefficients of the individual rotation lines in the band 3064 Å was close to that measured by means of thermocouples. It is shown that the concentration of the OH radicals is about 1000 times greater than the equilibrium concentration. It follows that a reaction chain is the chief source of OH in the combustion zone and that these radicals must play an important part in the mechanism of the thermal oxidation of H_2. AUTHORS.

3179. Flame of CO and O_2. H. Kondratjewa and V. Kondratjew. *Acta Physicochimica*, 6. 4. *pp.* 625–636, 1937. *In English.*—Following on previous work [see Abstract 3262 (1936)] an investigation is made of mixture composition on the intensity of visible radiation from the flame. Variation in the light yield is due to quenching of the chemiluminescence, and the O_2 quenching efficiency is found to be approximately five times that of the CO. The reaction mechanism is discussed at length. A. H.

See also Abstracts 2897, 3127.

THERMODYNAMICS.

3180. Second Law of Thermodynamics. A. Lindblad. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 15. [5 *pp.*], 1937. *In German.*—Results of experiments with a special type of photo-cell and with a type of Cu_2O rectifier lead the author to conclude that the second law of thermodynamics may not be so generally valid as is usually conceived. In the experiments cited, the work of Maxwell's " sorting demon " is performed by electronic mechanisms incorporated in the devices employed. J. S. G. T.

3181. Liquid State. K. F. Herzfeld. *J. of Applied Physics*, 8. *pp.* 319–327, *May*, 1937.—A critical survey of existing data which discloses the state of present knowledge with regard to the formulation of a theory of the liquid state. The characteristic physical properties dealt with include explanations for the viscosities of liquids, the distinctness of the liquid phase, and the fact that in general the compressibility, expansion coefficient and specific heat are greater than those of the solid phase whereas the density is smaller. X-ray investigation has led to the idea of the presence of small groups of similarly orientated molecules (cybotactic groups) and these are discussed in relation to the " microcrystalline " and " quasicrystalline " theories of liquid structure. In conclusion consideration is given to the progress which has been made in the direction of actually predicting the existence of the liquid phase. R. W. P.

3182. Series Evaluation of the Isotherm Data of CO_2. A. Michels and (Mrs.) C. Michels. *Roy. Soc., Proc.* 160*A*. *pp.* 348–357, *June* 1, 1937.—It is common practice to represent isotherm data by a series expression either with powers of the pressure or of the density, *e.g.*, either $pv = A + Bp + Cp^2 + \ldots$ or $pv = A + Bd + Cd^2 + \ldots$ Previously it has been shown that for isotherm data above 600 atmos. the first series is not adequate. The present paper shows that also the second series cannot represent accurately the isotherm data of CO_2 up to 3000 atmos. as published by the authors. The series representation is, however, still of value for interpolation purposes, if deviation curves between experimental data and series are known. The isotherm data have therefore been expanded in series of the type $pv = A + Bd + Cd^2 + Zd^3 + Dd^4 + Ed^6 + Fd^8$. The value of a coefficient depends on the density region for which the series is applied, the number of coefficients, etc., and it is therefore dangerous to draw too rigid physical conclusions from the numerical values. With the help of the series the results published have been compared with those published by other authors. [See following Abstract]. AUTHORS.

3183. Isotherms of CO_2 near the Critical Point and Round the Coexistence Line. A. Michels, B. Blaisse and (Mrs.) C. Michels. *Roy. Soc., Proc.* 160*A*, *pp.* 358–375, *June* 1, 1937.—In previous papers [see Abstract 80 (1936)] isotherm data of CO_2 have been published between 0° and 150° C. up to 3000 atmos. The method used could not be applied in the direct neighbourhood of the critical point and round the coexistence line. The present paper gives a description of a new method to measure isotherms in this region with an average accuracy of 1 : 5500, and the data obtained for CO_2 by this method. The principle of the method is to compress gas with mercury and to determine the change of volume of the gas from the weight of the mercury displaced. This weight is measured without the mercury being taken out of the apparatus. Besides the isotherm results, the vapour pressure curve, the critical data and the latent heat are given. The results do not support the doubts, which have been expressed lately in literature as to the real existence of a critical point. [See preceding and following Abstracts.] AUTHORS.

3184. Thermodynamic Properties of CO_2 up to 3000 Atmospheres between 25 and 150° C. A. Michels, A. Bijl and (Mrs.) C. Michels. *Roy. Soc., Proc.* 160*A*. *pp.* 376–384, *June* 1, 1937.—In previous papers [see preceding Abstract] the results of isotherm measurements on CO_2 and a method for interpolation of the *pv* values at intermediate temperatures and densities have been published. From the data obtained, the specific heat at constant volume C_v, the free energy F, the total energy U, and the entropy S, have been calculated, and the data are now given. It is found that the general character of the energy-density curves for the different temperatures is the same, and that they do not show any singularity at the critical density. The character of the graphical representation of the specific heat and its change with temperature suggests that two independent phenomena are superposed, *viz.*, a gradual increase of the specific heat with density and a specific influence of the critical density which fades out at the higher temperatures; these phenomena are discussed. H. H. Ho.

3185. Transitions in Condensed Systems. O. K. Rice. *J. Chem. Phys.* 5. *pp.* 492–499, *June*, 1937.—In this paper there is presented a method of studying transitions in condensed phases based on the thermodynamic equation $(\partial E/\partial V)_T = T(\partial S/\partial V)_T$, which holds for low pressures. $(\partial E/\partial V)_T$ and $T(\partial S/\partial V)_T$ are plotted as functions of V, the latter for various temperatures. Intersections of these curves give the points of equilibrium and the transition points. It is shown that very general and qualitative considerations, taking into account only facts that we definitely know to be true of these curves, with one very reasonable assumption, are sufficient to indicate that as the temperature of a system is increased from absolute zero there must be at least one change of phase, which is taken to be fusion. Changes of phase due to setting in of molecular rotation in the solid are also considered. Curves of N_2 and O_2 are constructed from available experimental data. Finally, an equation of Eyring and Hirschfelder [see Abstract 1889 (1937)] which would give the trend of the function $V(\partial S/\partial V)_T$ with V for liquids, is tested by a new method, and found not to accord very well with the experimental data, especially for low boiling substances. AUTHOR.

3186. Thermodynamic Treatment of Unsharp Phase Transformations. Part II. A. J. Rutgers and S. A. Wouthuysen. *Physica*, 4. *pp*. 515–520, *June*, 1937. *In German.*—A simple method is given for the thermodynamical study of unsharp phase transformations, which can also be applied to higher order transformations. The paradoxical stability of the λ-point is discussed, and for this case it is suggested that a solution can be obtained by the introduction of the new functions Z_α and Z_β. [For Part I see Abstract 1741 (1937).] R. W. P.

3187. Theory of Phase Transformations. Part II. L. Landau. *Phys. Zeits. d. Sowjetunion*, 11. 5. *pp*. 545–555, 1937. *In German.*—In a previous paper [see Abstract 2718 (1937)] a general investigation was published of transformations connected with alterations in symmetry, and in the present paper the problem is dealt with of relations between the different states of the substances. In §1, the impossibility is shown of the existence of crystals whose density function depends only on one or two coordinates. §2 concerns transitions between liquid and crystal, and it is established that between these phases no Curie points can occur on a curve in the *p*. T-diagram. §3 is devoted to liquid crystals and §4 to surface phases. H. H. Ho.

3188. Dependence of the Increase of Entropy in Quasi-Adiabatic Work-Processes upon Temperature and Velocity of Expansion. M. Paul. *Ann. d. Physik*, 29. 2. *pp*. 179–188, *May*, 1937.—The thermodynamics of quasi-adiabatic expansion and contraction of gases, *i.e.*, expansion or contraction at finite velocity (as contrasted with the infinitely small velocity contemplated in the usual type of adiabatic expansion) and without heat exchange, is discussed. While the work involved in a quasi-adiabatic expansion is smaller than that characterising the customary adiabatic expansion, the reverse is the case for the respective compressions. J. S. G. T.

3189. Validity of Raoult's Law for Paraffin Molecules of Very Different Length. J. H. Hildebrand. *Am. Chem. Soc.*, *J*. 59. *pp*. 794–798, *May*, 1937.—The lattice of fixed points as a frame of reference for calculating the entropy of binary solutions is applicable only to pairs of molecular species of equal size or, at most, to molecules whose size and shape permit them to occupy a definite number of lattice points. If a solution of long paraffin molecules is somewhat idealised as a parallel arrangement, the number of possible interchanges is the same as it would be for spherical molecules of equal size in a point lattice. This leads to the entropy and free energy of an ideal solution. The rather meagre experimental evidence supports the ideal character of such solutions. AUTHOR.

3190. Thermodynamic Functions for Molecules Having Restricted Internal Rotations. K. S. Pitzer. *J. Chem. Phys*. 5. *pp*. 469–472, *June*, 1937.—The partition function is considered for molecules having restricted internal rotations, and expressions are obtained which are reasonably accurate for most actual molecules. Tables are presented which list the contributions of a single restricted rotational degree of freedom to the entropy, energy, free energy, and heat capacity. [See following Abstract.] AUTHOR.

3191. Thermodynamics of Gaseous Hydrocarbons. K. S. Pitzer. *J. Chem. Phys.* 5. *pp.* 473–479, *June,* 1937.—It is pointed out that the assumption of completely free internal rotation in the simpler hydrocarbon molecules is probably responsible for the discrepancies between the results of previous statistical mechanical calculations and the experimental data. Using the formulæ and tables of the preceding paper [see preceding Abstract], calculations are presented which show that, for reasonable values of rotation restricting potentials, complete agrement can be obtained with all experimental results. The uncertainty as to the exact height and shape of these potential barriers, together with the possible errors in estimated vibration frequencies make highly precise calculations of thermodynamic functions out of the question at present. Nevertheless the general agreement with experiment indicates that the potentials and frequencies selected must be approximately correct. These molecular structure data together with the available values of heats of combustion and hydrogenation are then employed in calculations which yield thermodynamic constants and the free energy of formation as a function of the temperature in the range from 300 to 1500° K. The various calculations have been made for ethane, ethylene, propane, propylene, n-butane, *iso*-butane, 1-butene, *cis* and *trans* 2-butenes, *iso*-butene and neopentane (tetramethylmethane). AUTHOR.

3192. Virial Theorem. E. L. Hill. *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 458–461, 1937. *In English.*—Recently Hellmann [see Abstract 3755 (1936)] has questioned the validity of certain applications made by Bridgman and the author independently, and he advances the view that the virial theorem supplies our definition of the mean kinetic and potential energies in complex molecular systems and cannot be used for arguments concerning the internal structure of such systems. As the result of correspondence with Hellmann, the author opines that most of the divergence of opinion is probably due to misunderstanding of purpose rather than to questions of mathematical accuracy and in this paper his point of view is clearly stated. H. H. Ho.

3193. Elastic Thermal Waves in Liquids. R. Lucas. *Comptes Rendus,* 204. *pp.* 1631–1632, *May* 31, 1937.—The value of approximately 18×10^5 cm./sec. has been obtained experimentally for water for the constant ϕ which occurs in the equation for the pressure difference set up by thermal waves in a liquid [see Abstract 2724 (1937)]. It is considered that this velocity is of the order to be expected if the thermal conductivity is mainly due to transverse wave motions. R. W. P.

See also Abstracts 2867, 3158, 3159.

VAPOUR PRESSURE.

3194. Extended Vapour-Pressure Chart for Hydrocarbons and Petroleum Products. E. S. L. Beale. *Inst. Petroleum Technologists, J.* 23. *pp.* 311–315, *May,* 1937.—The boiling-point conversion chart previously published (Beale and Docksey, *ibid.* 21, *pp,* 860–870, *Oct.* 1935) has been extended to cover pressures above atmospheric for the estimation of vapour pressures in fractionating column calculations. A modification of the same chart is given to show how it can be used for adjusting the boiling point of residues from crude oil for small pressure changes, as is required in the calculation of equilibrium temperatures. **Author.**

3195. Vapour Pressure of Phosphorus Pentoxide. J. C. Southard and R. A. Nelson. *Am. Chem. Soc., J.* 59. *pp.* 911–916, *May*, 1937.—The vapour pressure of P_2O_5 is found to be entirely reproducible and independent of the rate of distillation of the sample. The data are interpreted to show that P_2O_5 exists in a low temperature and a high temperature crystalline form and as a liquid. The atmospheric sublimation temperature of the low temperature form is found to be 358·9°. The triple point between the high temperature crystalline form, the gas and the liquid is found to be at a pressure of 45·6 cm. of Hg and at a temperature of 565·6°. The rate of transition from the low to the high temperature form is undetectable below 360°. **Authors.**

3196. Vapour Pressure of Capillary-Absorbed Substances and Measurement of Molecular Diameters. D. Rădulescu and S. Ţilenschi. *Zeits. f. phys. Chem.* 179. *Abt.A.* 3. *pp.* 210–226, 1937.—Since the Helmholtz-Kelvin thermodynamical relationship between capillary diameter and vapour pressure must also be applicable for dilute molecular layers, it is deduced that in the region where the capillary diameter only attains 10^{-7}cm. a pronounced discontinuity of the corresponding vapour pressure curve should be expected: the *p/r* curve should prevent a stepwise appearance. The intervals between the steps may be calculated from the values of the surface tension, the density, the vapour pressure at normal surfaces and the molecular diameter. Conversely the latter data may be obtained from the interval values. It is also shown that the number of molecules which occur in the capillary diameter and which form a meniscus of only few molecular diameters, enable only a springwise alteration of the meniscus so that instead of a continuous series of curvature radii, there occurs discontinuity. These theoretical expectations have been confirmed throughout by measurements of the desorption pressure of benzene in active charcoal, the data being in excellent agreement with the calculated values. In consequence a new method is now available for the determination of the molecular radius in the liquid state; the average value of the step-interval is approximately equal to the molecular radius. **H. H. Ho.**

See also **Abstracts 3174, 3189.**

ACOUSTICS.

3197. Violin Tone. H. Meinel. *E.N.T.* 14. *pp.* 119–134, *April*, 1937.—A detailed experimental study of the constructional factors, particularly the thickness of the wood, which determine the tonal quality of the sound emitted by a violin. The extent of the motion of the various parts of the woodwork was surveyed with an electrostatic vibration detector, and related to the harmonic content of the emitted sound wave, the frequency spectra of typical sounds being given. Criteria for an ideal violin sound are derived and the author indicates how these can be met in design, a comparison being made with a Strad. L. E. C. H.

3198. Absorption of Supersonic Waves in Liquids. F. A. Korolev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R,* 15. 1. *pp.* 35–36, 1937. *In French.*—Using Toeppler's method to measure the absorption of supersonic waves in liquids, results are obtained for the absorption in toluene and benzene which are in good agreement with those obtained by the diffraction method. The author points out the advantages of Toeppler's method, *viz.*, that it can be used if the absorption is large, or if, as often occurs, the supersonic field produced by a quartz crystal is, instead of a single plane wave, a complex set of divergent rays. K. M. C.

3199. Action of Audio-Frequency Alternating Current on the Ear. G. Gersuni. *Techn. Phys., U.S.S.R.* 4. 2. *pp.* 163–174, 1937. *In German.*—An investigation is made of the musical sounds heard when a.c. is passed through the human ear. It is shown that the sound is still heard if the outer and middle ear are defective or anesthetised but that if the inner ear is defective only a " rushing " noise is heard. For frequencies less than 100∼ the sounds heard by normal and defective ears are similar and consist of the " rushing " sound only. It is concluded that the " rushing " noise is produced by the direct action of the current upon the auditory nerve, the musical component arising from its action upon the inner ear mechanism. K. M. C.

3200. Octaves and Decibels. R. Vermeulen. *Philips Techn. Rev.* 2. *pp.* 47–56, *Feb.*, 1937.—With the aid of practical data, the relationships are discussed between the acoustic magnitudes, pitch interval and loudness, and the corresponding physical magnitudes, frequency and sound intensity. The object of this article is to emphasise that the logarithmic units, octaves and decibels, should be given preference in acoustics for denoting physical magnitudes. AUTHOR.

3201. Interference Effect of the Wall of a Pipe on a Rayleigh Disc. S. Tomotika. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 329–336, *April*, 1937. *In English.*—The author recalls a result obtained in an earlier paper [see Abstract 883 (1933)] that the couple due to the fluid pressure acting on a flat plate in a steady stream of an incompressible fluid flowing in a channel between two parallel plane walls is increased due to the influence of the walls of the channel. It is suggested that this is similar to the influence of the wall of the pipe on the couple acting on a Rayleigh disc. The calculated values of this increase are compared with unpublished measurements made by K. Sato upon a Rayleigh disc for frequencies 250–4000∼ and with various diameters of disc and tube. The calculated and observed values agree, both showing an increase in the couple as the ratio pipe diameter/disc diameter tends to unity. K. M. C.

See also Abstracts 2938, 3278.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 3266.

CONDUCTION AND DISCHARGE IN GASES.

3202. Stability and Other Properties of Corona Discharge. L. G. H. Huxley and J. H. Bruce. *Phil. Mag.* 23. *pp.* 1096–1114, *June*, 1937.—With a view to illustrating the principal features of discharges in non-uniform fields, the corona discharge is discussed in relation to the general theory and the conditions which determine the transformation of the stable corona discharge from wires and the brush discharge from points into the unstable disruptive form on increase of current is examined. H. J. H. S.

3203. Townsend Current and Effect of Irradiation on the Striking Potential of a Glow Discharge. R. Schade. *Zeits. f. Physik,* 105. 9–10. *pp.* 595–619, 1937.—The effect of space charges on a discharge of small current density which takes place between parallel plane electrodes is examined theoretically. The characteristic of the Townsend current is a straight line. By irradiation of the kathode, the glow discharge strikes at a potential which is lower than the normal striking potential, provided the current density has an appropriate value. The lowering of the striking potential as well as the striking current density are proportional to the square root of the primary current density. The suggestion put forward by Rogowski that these phenomena are determined by the field strength dependence on the constant γ seems to be satisfactory at low pressures. The theoretical part of the paper is followed up by an experimental investigation in which the principal theoretical deductions are verified. H. J. H. S.

3204. Critical Potentials of Carbon Monoxide. J. Savard. *Soc. Roumaine Phys., Bull.* 38. 68. *pp.* 17–27, 1937. *In French.*—By the direct method of electron impact, the author finds between 12 and 26 V, 38 excitation potentials of the CO molecule. By aid of special experimental arrangements, he obtains several critical values, corresponding to additive combinations of spectral terms. The ionisation potential of the molecule is computed at 13·5 V. Some other critical potentials, the highest being 19·45 V, are due to molecular ions. The potentials above 20 V correspond to atomic ions. The comparison between the author's results and those obtained by the mass spectrograph method are in good agreement. AUTHOR.

3205. Ionisation Potentials of the Free Radicals Methyl and Ethyl. R. G. J. Fraser and T. N. Jewitt. *Roy. Soc., Proc.* 160*A*. *pp.* 563–574, *June* 15, 1937.—The ionisation potentials of free methyl and free ethyl are measured by a molecular beam method. The beam of free radicals, formed in the source by the thermal decomposition of the corresponding tetra-alkyl lead, is received at an ionisation gauge, and curves relating positive ion current to electron energy are obtained. Extrapolation of these curves to meet the axis of abscissæ determines the ionisation potentials, the scale of electron energies being corrected against that of methyl iodide. AUTHORS.

***3206. Low-Voltage Proton Sources. E. S. Lamar, W. W. Buechner and K. T. Compton.** *Phys. Rev.* 51. *pp.* 936–941, *June* 1, 1937.—Further experiments have been made for increasing the proton percentage obtainable from capillary arc sources previously described [see Abstract 290 (1936)]. The collision method of breaking up molecular ions have been investigated. Although no difficulty was experienced in refocusing the scattered ions, no evidence was found for break-up in the absence of magnetic fields. Rather than investigate these possibilities further, a quartz capillary was tried, using a simple bevelled outlet. This eliminated the rapid disintegration of the quartz by secondary electrons from any probe electrode, but there was still evidence of gradual disintegration of the quartz by low speed electrons in the discharge. The absence of excessive heating indicated that the capillary might as easily be made of pyrex. A pyrex capillary source was therefore tried. In a 3·5 mm. capillary, heating was not excessive at arc currents below 0·3 A. The proton percentages ranged up to 20%. Following the experience of Wood, water vapour was introduced, and resulted in a marked increase in the proton percentage (a factor of about 4). This source possesses the advantages of slightly greater ion current efficiency, requires no cooling, is easily constructed, and is free from impurities. AUTHORS.

3207. Oxidation of Nitrogen in the H.F. Glow Discharge. Parts I and II. E. N. Erjemin, S. S. Wassiljew and N. I. Kobosev. *Acta Physicochimica*, 6. 3. *pp.* 347–370, and 6. 4. *pp.* 531–554, 1937. *In German.*—In Part I previous work in this field is first reviewed, following which comes a description, with experimental details, of the kinetics of N_2 oxidation in the h.f. discharge (2·7 × 16~). It is shown that the equation derived earlier for the reaction corresponds well with the conditions of the h.f. discharge, and that the energetic effectivity of a discharge of frequency 2·7 × 10^5~ and 70 W power at a pressure of 180 mm. is three times as great as the energetic effectivity of a discharge of 50~ at the same power. In Part II a comparison of the frequencies of 2·7 × 10^5, 5 × 10^5, 7 × 10^5 and 10^6~ for two different wattages has established the complete identity of their effects for the oxidation of N_2 in the electric discharge, and indicates an absence of chemical resonance the existence of which is asserted in the literature. The effect has also been investigated of the effect of the superposition of an external h.f. field on a lower frequency discharge, the results indicating that this combined type of discharge approaches the h.f. field in chemical effect. H. H. Ho.

3208. Chemical Reactions in Electrical Discharges. Part III. S. Roginsky and A. Schechter. *Acta Physicochimica*, 6. 3. *pp.* 401–418, 1937. *In German.*—This paper continues previous work [see Abstract 3298 (1936)] and deals with the recombination of H and N atoms at Pt and W surfaces over a wide temperature range. Whereas at Pt the recombination coefficients were determined, no recombination could be established for N atoms at W. The stabilising effect of A upon atomic N and O was proved, and the importance of this phenomenon analysed. Different observations on the recombination of O atoms at oxides and metallic surfaces are also described. Experimental details are included. H. H. Ho.

***3209. Recent Developments in Geiger-Müller Counters. P. B. Moon.** *Journ. Sci. Instruments*, 14. *pp.* 189–193, *June*, 1937.—Review of recent developments in the construction and operation of tube counters and of modifications of the accompanying circuits. F. C. C.

3210. Addition of Saturated Vapours to Tube Counters. A. Trost. *Zeits. f. Physik,* 105. 7–8. *pp.* 399–444, 1937.—It is shown with a kathode-ray oscillograph that the normal counter impulse with air or argon filling, which consists of several single discharges, may be reduced to a few discharges by the addition of saturated vapours. The discharge is no longer self-maintained and the time constant is independent of the leakage resistance. It was also established that the magnitude of the impulse and the value of the onset potential depended only on the nature of the gas and the dimensions of the counter and was independent of the material and conditions of the electrodes. The nature and state of the kathode surface, however, had considerable influence on the time constant. The optimum pressure was a total of 100 mm. of Hg with 10 % vapour. Different organic vapours were used and a correlation between chemical structure and counter behaviour was established. Reproducible results were obtained only with hard rubber or amber insulation. The effect of temperature on the counter characteristics was easily demonstrated. F. C. C.

***3211. Self-Excitation of Geiger-Müller Counters. W. I. Wechsler and A. W. Biberhall.** *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 326–343, 1937. *In German.*—The corona discharge in counter tubes is studied. The characteristics show a hysteresis effect which is traced to a warming-up of the tube by the discharge. The conclusion is drawn that the increase of natural effect which is sometimes observed, is due to a slight temperature increase in the counter, which reduces the potential up to which the counter can be satisfactorily used. R. P.

***3212. Generation of Constant D.C. Voltage for Valve Counting Apparatus. E. Schopper and R. Mühleisen.** *Zeits. f. techn. Physik,* 18. 5. *pp.* 117–119, 1937.—The conditions which must be satisfied by valve counting apparatus are given and a method of generating a sufficiently constant d.c. voltage is described. A description is then given of a h.v. arrangement in which the 3000 V d.c. voltage is stabilised by means of a positive corona discharge. Operating data and requirements are given and it is shown that the use of the corona discharge for potential stabilisation is entirely satisfactory for this purpose. A. W.

3213. Influence of Slow Positive Potassium Ions on Metallic Surfaces. W. Brummack. *Zeits. f. Physik,* 105. 7–8. *pp.* 468–469, 1937.—It is known that metallic surfaces are affected in different ways by bombardment with electrons and alkali ions. A description is given of an apparatus in which this effect may be studied. K ions with energies up to 200 V and with current densities of the order of 10^{-8} A are allowed to bombard sheets or thin layers of various metals or of Ag or Au films sputtered on glass for periods of 1 to 15 min. For certain metals a number of "developers" are found by which a visible impression may be produced of the region of bombardment, although before "development" no visible imprint is obtainable. H. J. H. S.

See also Abstracts 2888, 3087, 3097, 3098, 3099, 3236, 3237, 3280.

CONDUCTION IN SOLIDS AND LIQUIDS.

3214. Connection between Sommerfeld's and Frenkel's Electron Theory of Metals. M. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 1136–1140, *March,* 1937. *In German.*

***3215. Electrostatic Voltmeter for High Voltages. C. W. Lampson.** *Rev. Sci. Instruments*, 8. *pp.* 165–169, *May*, 1937.—Instrument takes the form of a hollow copper sphere, which is brought near to the source of voltage to be measured. The mechanical force on the surface of the sphere due to the electrostatic field operates the indicating mechanism. A sector of the sphere is cut out and suspended in its original position by a bifilar suspension inside the sphere, arranged so that the motion of the sector is radial for small displacements. The motion is magnified by a simple pivot-mechanism, and is indicated by a pointer and scale. The control is gravitational. The instrument is calibrated by means of a microammeter and high resistance (2×10^{10} ohms) or the force-constant may be determined by the use of an electrostatic field of calculable form (*e.g.*, two equal spheres). The instrument is always earth-connected, and its distance from the high-potential source should be such that the maximum field intensity at the surface of the sphere is about 10 kV/cm., which corresponds to full scale reading. The air damping is nearly critical. L. H.

***3216. Potentiometer for Measurement of Small E.M.F.s and Resistances. C. H. Johansson.** *Journ. Sci. Instruments*, 14. *pp.* 194–198, *June*, 1937.—A slide-wire potentiometer, modified for the purpose of reducing the disturbing thermo-e.m.f.s, is described. The potentiometer has two parallel manganin wires. A manganin roller connecting one point of the resistance wire with an adjoining point of the parallel wire constitutes the potential terminal at the wire. Thus sliding contacts and the use of different metals at the contacts are avoided. The junctions between the manganin wires in the potentiometer and external copper wires are connected to a number of copper discs with good thermal contact although they are electrically insulated. This arrangement considerably reduces the temperature differences between the various points of connection. A simplified potentiometer for measuring small resistances only is described. Finally a design of a switch free from thermo-e.m.f.s is given.
AUTHOR.

3217. Temperature Variation of Electrical Conductivity of a Thin Film of NaCl and Rock-Salt. H. Saegusa and T. Matsumoto. *Tohoku Univ., Sci. Reports*, 25. *pp.* 805–816, *March*, 1937. *In English.*—The electrical conductivity of a thin film of NaCl about 10^{-4} cm. in thickness was measured for various temperatures and it was found that the variation of the electrical conductivity with the temperature of a fresh film nearly satisfied the formula $\log\sigma = B + A/T$, and that after heating the film up to 160° C., its electrical conductivity satisfied extremely well the above expression, and further the magnitude increased to about one-tenth of that of the fresh film. To explain this fact the X-ray pattern by the Debye-Scherrer method and the reflection pattern by the electron beam were taken, and these confirmed the fact that the thin film made by the evaporation of a NaCl crystal showed a fibrous structure and that it became sharp as the film was heated. The variation of the electrical conductivity with the temperature of a natural rock-salt crystal and an artificial NaCl crystal were also investigated and it was found that the latter satisfied closely the above equation. AUTHORS.

3218. Latent Heat of Tin while Passing from the Supraconductive to the Non-Supraconductive State. W. H. Keesom and P. H. van Laer. *K. Onnes Lab., Leiden. Comm. No.* 248*c*. *Physica*, 4. *pp.* 487–493, *June*, 1937. *In English.*—In this paper we give the results of a few latent heat measurements carried out on tin while it is passing from the supraconductive to the normal state by increasing the external magnetic field at constant temperature. The values of the latent heat thus measured agree very well with the formula derived on thermodynamical basis, from which it is again concluded that the transition process is reversible. The disturbance of the supraconductivity of the block of tin as far as it is indicated by caloric effects occurs at the same critical fields as determine resistance and induction phenomena. Some remarks are made concerning the way in which the block passes from the supraconductive to the normal state. [See also Abstract 3308 (1936).] AUTHORS.

3219. Relaxation Phenomena in Supraconductivity. W. H. Keesom and P. H. van Laer. *K. Onnes Lab., Leiden. Comm. No.* 248*d. Physica,* 4. *pp.* 499–502, *June,* 1937. *In English.*—Calorimetric measurements carried out on a massive block of tin showed in every respect the same relaxation phenomena as were observed in previous experiments on a block of a complicated internal structure. It follows from a comparison of our results with those of other experimenters that it is necessary to distinguish between several different kinds of relaxation and hysteresis phenomena. [See also Abstract 1808 (1936).] AUTHORS.

3220. Resistivity of Boron. E. Podszus. *Ann. d. Physik,* 29. 1. *pp.* 61–62, *May,* 1937.—The measurements of Henninger [Abstract 1339 (1937)] are discussed in relation to earlier measurements of the author. R. P.

3221. Effect of Annealing on the Electrical Resistance of Cold-worked Platinum. W. Meissner. *Ann. d. Physik,* 29. 3–4. *pp.* 264–272, *June,* 1937.—The resistance of a Pt wire, measured at 20° K. after drawing through successively smaller dies, is shown to increase as its diameter is reduced from 0·15 mm. to 0·10 mm. and then remain fairly constant. Four wires of different purity were annealed at different temperatures for various times. It is considered that the effects of the cold working are removed at a lower temperature than that at which a noticeable recrystallisation occurs. If heated beyond this lower temperature there is a definite increase in the resistance. The smallest resistance is obtained after annealing at about 750° C. for 30 min. The purest wire, which only contained traces of Cu and Ca gave a resistance at 1·3° K. of $0\cdot3 \times 10^{-3}$ of that at 0° C. R. W. P.

3222. Specific Resistance of Tellurium. E. Schmid and F. Staffelbach. *Ann. d. Physik,* 29. 3–4. *pp.* 273–278, *June,* 1937.—Measurements are made of the specific resistances of single crystals of Te for various values of ϕ, the angle between the principal axis of the crystal and the direction of measurement. The resistance data are in agreement with the equation $\rho_\phi = \rho_\perp + (\rho_\parallel - \rho_\perp)\cos^2 \phi$, the values at 20° C. in directions parallel and perpendicular to the axis being $\rho_\parallel = 0\cdot028_3$ and $\rho_\perp = 0\cdot061_3$ Ω cm. These values, as well as the degree of anisotropy, are smaller than found by Bridgman [see Abstract 681 (1926)]. Various methods are used to calculate the specific resistance of a quasi-isotropic polycrystalline specimen, but the results are not in agreement with measured values, presumably owing to the porous nature of the crystal. R. W. P.

3223. Physical Properties of Silver-Tin Alloys. W. G. John and E. J. Evans. *Phil. Mag.* 23. *pp.* 1033–1048, *June,* 1937.—The constituent metals are melted together under carbon, the alloy being remelted before casting. The graphite mould is used cold for Sn-rich alloys and preheated for Ag-rich alloys. Plates with a Ag_3Sn lattice (70–80 % Ag) are cast *in vacuo*. Suitable annealing temperatures are deduced from the equilibrium diagram the annealing being followed by slow cooling. Composition is checked by analysis. Resistivity remains constant at $10\ \Omega^{-6}$ cm.$^{-1}$ up to 73·5 % Ag then rises to a sharp peak at 75 at 81 % Ag, subsequently dropping smoothly to 1·51 for pure Ag. The Hall coefficient $\times 10^4$, at 8346 gauss, rises smoothly from $-0{\cdot}5$ for pure Sn to 4·2 at 72·4 % Ag. Since the effect is small, thin plates are used to accentuate it, leading to a possible error over 2 %. Thermoelectric power against Cu between 15° and 100° C. rises smoothly from $-3{\cdot}2$ mV/degree for Sn to $-0{\cdot}6$ at 73·2 % Ag. Temperature coefficient of resistance $\times 10^4$ drops slowly from 43·7 for Sn to 35·8 at 73·2 % Ag. [See also Abstract 4833 (1936).] D. R. H.

3224. Conductivity and Viscosity of Fused Salts. J. Frenkel. *Acta Physicochimica*, 6. 3. *pp.* 339–346, 1937. *In English.*—It has been recently shown experimentally that the electrical conductivity, σ, and the viscosity, η, of ionic solutions are related by the equation $\sigma^m \eta = \text{const.}$ This result is deduced theoretically for a solution of a binary salt and it is shown that $m > 1$, except where the ionic dissociation is incomplete. A modified equation in the form $\sigma^m\eta = \text{Const}/T^{m-1}$ is derived. The viscosity of liquid mixtures is briefly discussed. J. S. G. T.

3225. Conductivity and Viscosity of the Systems H_2SO_4–$CHCl_2COOH$ and H_2SO_4–$CH_2ClCOOH$. W. Tartakowskaja, J. Bondarenko and L. Jemeljanowa. *Acta Physicochimica*, 6. 4. *pp.* 609–624, 1937. *In German.*—Specific conductivities and viscosities are determined for the systems H_2SO_4–$CHCl_2COOH$ and H_2SO_4–$CH_2ClCOOH$ at different concentrations and at temperatures between 20° and 80° C. In both systems the conductivity-composition curves and the viscosity-composition curves show maxima. The temperature coefficient of conductivity is plotted against composition for the two systems and the fact that the curves show maxima at 50 per cent H_2SO_4 is taken as indicating the formation in both cases of chemical compounds containing one molecule of each component. L. A. W.

3226. Conductivity of Solid Dielectrics at High Field Strengths. F. Quittner. *Phys. Zeits. d. Sowjetunion*, 11. 4. *pp.* 359–368, 1937. *In German.*—By a critical discussion of the views expressed by other physicists, the author comes to the conclusion that his statement that there are measurable deviations from Ohm's law at about 10^4 V, is generally confirmed. These deviations, according to his view, are not due to impurities in the material, but are intrinsic properties of the dielectric. R. P.

3227. Electric Conduction in Mica in Strong Fields and at High Temperatures. W. Pruschinina-Granowskaja. *Phys. Zeits. d. Sowjetunion*, 11. 4. *pp.* 369–389, 1937. *In German.*—The nature of the carrier of the current through thin mica films is investigated by a chemical analysis of the deposits on both electrodes. It is found that the increase of conductivity in strong fields is completely electronic. At low temperatures the conduction is predominantly electronic, while at higher temperatures ions mainly those of Al and O, also give a contribution. By extrapolation to weak fields it is concluded that at low temperatures and weak fields the conduction is predominantly ionic. R. P.

See also Abstracts 3149, 3161.

DIELECTRICS AND CAPACITANCE.

3228. Dielectric Constant and Molecular Size of Duprene and Rubber Hydrochloride. N. J. Li. *Chinese Chem. Soc., J.* 5. *pp.* 117–123, *May,* 1937. *In English.*—A study of the dielectric constant at various frequencies is made for the systems of rubber hydrochloride and of duprene in various solvents. The results do not show any anomalous dispersion. Explanations for the apparent non-polarity of these compounds are attempted. AUTHOR.

3229. Absolute Measurement of Dielectric Constants of Fluids and Solids at Ultra-High Frequencies. R. King. *Rev. Sci. Instruments,* 8. *pp.* 201–209, *June,* 1937.—A new parallel wire method has been devised for measuring the dielectric constants of fluids and solids at ultra-high frequencies. A relatively small sample in the form of a thin slab is required. The mathematical relation upon which the experimental determination depends involves only the wave-length at which the measurements are made, the thickness of the sample, and a bridge shift along the parallel wires measured in air. This relation is derived, the experimental technique is outlined, and sample results obtained with water and alcohol are given. AUTHOR.

3230. Dielectric Constants and Absorption Coefficients in the Region of Ultra-Short Waves. W. I. Romanow. *Phys. Zeits. d. Sowjetunion,* 11. 4. *pp.* 404–413, 1937. *In German.*—The resonance curve is calculated for a system consisting of a condenser which is closed through two long parallel wires. It is assumed that the wave-length is much longer than the dimensions of the condenser. It is shown that by measuring the resonance curve as a function of the length of the parallel wires, or of the size of the condenser, both the dielectric constant and the apparent conductivity of the dielectric can be obtained. R. P.

3231. Dielectric Constant of Titanium Dioxide at Low Temperatures. H. Büttner and J. Engl. *Zeits. f. techn. Physik,* 18. 5. *pp.* 113–117, 1937.—The dielectric constant of titanium dioxide is found to be practically independent of temperature over the range 0 to − 180° C. It is concluded that there is no evidence of dipole effects such as are held responsible for the anomalous temperature variation of dielectric constant of Rochelle salt. E. R.

3232. Dielectric Constants of Cyclohexane and Benzene. Jacqueline Hadamard. *Comptes Rendus,* 204. *pp.* 1234–1235, *April* 26, 1937.—By means of a modification of the Nernst bridge method the dielectric constants of C_6H_6 and cyclohexane were determined for temperatures 9·2°–40·3° (22 temperatures) and 6·2°–38·15° (20 temperatures) respectively. The variations with temperature for C_6H_6 are accurately linear. C. A. S.

3233. Dielectric Properties of Acetylenic Compounds. B. C. Curran and H. H. Wenzke. *Am. Chem. Soc., J.* 59. *pp.* 943–944, *May,* 1937.—Electric moments are determined for butyl-, amyl-, phenyl- and *p*-tolylpropiolnitriles. The values obtained for these moments prove the existence of resonance in these molecules as well as in the alkyl and aryl halogenoacetylenes. The electromeric polarisability of the acetylene triple bond is shown to be greater than that of the phenyl group. AUTHORS.

3234. Dipole Moment and Solvent. Parts II and III. K. Higasi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 698 *and* 699. *pp.* 311–320, *May,* 1937. *In English.*—In Part II the electric moments of diethyl and triethyl amines are measured in hexane and benzene solutions, with the results: $NH(C_2H_5)_2$ $1\cdot10_3$ D, $1\cdot13_1$D, and $N(C_2H_5)_3$ $0\cdot74_9$ D, $0\cdot78_9$ D, respectively. The moment of solution increases with the increase in the dielectric constant of solvent. It is shown that this tendency is true also for the vapours. In Part III the apparent moments in solution of di-iso-propyl ketone are measured in benzene, hexane and CS_2 solution. The comparison of the results with those of acetone is made. A negative solvent effect is observed in spite of its negative value in the Kerr constant. [For Part I see Abstract 1820 (1936).] AUTHOR.

3235. Positive Electric Saturation. A. Piekara. *Comptes Rendus*, **204.** *pp.* 1106–1108, *April* 12, 1937.—Debye's theory fails to account quantitatively for the decrease in the dielectric constant of liquids with increase of field intensity, even when the theory is modified by the introduction of inter-molecular forces. The author has investigated nitrobenzene solutions in benzene and has found that the saturation effect changes sign, becoming positive at a concentration of 93%, and increasing rapidly with higher concentrations. The phenomenon is, however, easily masked by traces of impurities. An explanation is suggested by the author according to which two dipoles coming together tend to exert a couple on each other and the effect of the field is, statistically, to produce an increase of electric moment. When this effect exceeds that due to Debye's decrease of dielectric constant, the author's results are qualitatively explained. A. M. T.

3236. Influence of CCl_4 Vapour on Puncture Voltages of Air. G. M. Kovalenko. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 9. *pp.* 545–548, 1937. *In English.*—The sparking potentials under the same circumstances, save that in one case the atmosphere between the electrodes was pure air, and in the other was partly or solely CCl_4 vapour, are compared. In all cases presence of CCl_4 vapour increases the potential, the amount attaining 1·8 to 2·5 times, the greatest increase being when one electrode is a point, the other a sphere. The potentials in a mixed atmosphere are equal to the sum of the potentials in separate atmospheres of the two constituents at their respective partial pressures. [See Abstract 1859 (1936).] C. A. S.

See also Abstracts 2980, 2990, 3133.

ELECTROCHEMISTRY.

3237. Glow Discharge Electrolysis. A. Klemenc and R. Eder. *Zeits. f. phys. Chem.* 179. *Abt.A.* 1. *pp.* 1–15, 1937.—Continuing previous work [see Abstract 866 (1935)] the authors investigate the behaviour of chloric and perchloric acids and their salts in glow discharge electrolysis. Reduction occurs in both anodic and kathodic cases. For chloric acid the reduction gives hydrochloric acid directly, and shows the greatest observed excess over the Faraday equivalent, i.e. 40 times at a concentration of 2·5 molar. The reduction is considered to be effected by the action of excited water molecules and an expression is derived which is in agreement with the observed dependence of yield upon concentration. As was previously observed for H_2SO_4, the production of explosive mixture ($2H_2 + O_2$) is greatest when the simultaneous reduction of the electrolyte is least. L. A. W.

3238. Transport Numbers of Ions in Solutions of Silver Dodecyl Sulphate. O. R. Howell and H. Warne. *Roy. Soc., Proc.* 160*A*. *pp.* 440–454, *June* 1, 1937.—The change in the transport numbers of the ions with increasing concentration of silver dodecyl sulphate, as determined by the Hittorf method at 40°, occurs in three distinct ranges corresponding with those of the electrical conductivity, viz. (1) Where the conductivity falls in accordance with the Onsager equation, the transport number of the anion falls rapidly; the mobility of the anion falls rapidly whilst that of the kation increases slightly. These facts are consistent with the theory that the salt is present as a simple completely dissociated electrolyte. (2) Where the conductivity falls extremely rapidly, the transport number of the anion rises rapidly to a value greater than unity; the mobility of the anion increases while that of the kation falls rapidly. The explanation advanced is that the long-chain ions are unable to pass one another and therefore move as a complete network through which the kations are unable to pass; the alternative theory that micelles are being formed over this range does not account for all the facts. (3) Where the conductivity remains almost constant or increases slightly, the transport number of the anion decreases slightly; the mobility of the anion decreases slightly whilst that of the kation increases slightly. All these facts are compatible with the theory originally postulated by McBain that micelles are present over this range, and are due to the collapse of the long-chain network; with further increasing concentration of the electrolyte, new and smaller micelles are produced. H. H. Ho.

3239. Electrochemical Behaviour of Rhodium. Parts II and III. G. Grube, Gu Bau-tschang, and K. H. Mayer. *Zeits. f. Elektrochem.* 43. *pp.* 397–406, *June*, 1937.—Earlier work is continued [see Abstract 801 (1934)], and the higher stages of oxidation of Rh are studied. It is shown that electrolytic oxidation in solutions of H_2SO_4 converts trivalent Rh into a stage of oxidation of 4·5, while in $HClO_4$ a valency of 5·8 is reached. The existence of hexavalent Rh is substantiated. The potentiometric titration of the higher stages of oxidation of Rh gave values 20 to 30% lower than the iodometric titration. The results showed that in the electrometric titration of anodically oxidised solutions of rhodium perchlorate with ferrous ammonium sulphate the hexavalent stage of oxidation of Rh is practically reached. F. J. B.

***3240. Aluminium Amalgam Electrode. Z. J. Berestneva and V. A. Kargin.** *Acta Physicochimica*, 6. 3. *pp.* 320–326, 1937. *In English.*—A new type of Al amalgam electrode has been worked out, which permits of measuring the potential of Al amalgam in aqueous solutions with an accuracy ± 1 mV. The content of Al in the amalgam must not exceed 6×10^{-4} % by weight. The potential of the Al amalgam electrode in aqueous solutions of pure $AlCl_3$ at concentrations from 1 *N* to 0·001 *N* has been measured. The possibility of applying the Al amalgam electrode to the measurement of the activity of Al ions in aqueous solutions has been shown. AUTHORS.

3241. Change of Polarisation of Electrodes with Time. O. Essin, L. Antropov and A. Levin. *Acta Physicochimica*, 6. 3. *pp.* 447–454, 1937. *In German.*—Measurements of the change of polarisation at short time intervals on a Cu kathode during the deposition of Cu showed that an abnormal high initial polarisation took place. This phenomenon was not accompanied by the formation of a new phase. It was shown that this "over polarisation" took place over a range of concentration of Cu from very small concentrations to that corresponding to equilibrium. It was also found that the "over-polarisation," like the ordinary polarisation, increased with the increase of the current density, and decreased with the increase of copper concentration and rise of temperature. F. J. B.

3242. Overvoltage of Hydrogen on Mercury and the ζ-Potential. Part I. S. Lewina and W. Sarinsky. *Acta Physicochimica*, 6. 4. *pp.* 491–504, 1937. *In German.*—A method is described for the determination of the overvoltage of H_2 on a Hg electrode, the surface of which can be renewed as desired. Measurements are given for the overvoltage in 0·001, 0·01, and 0·1 N solutions of HCl. The current densities range from 10^{-8} to 10^{-3} A/cm². The influence of impurities on the kathode surface on the overvoltage is demonstrated. F. J. B.

3243. Flow-Potentials on Platinum. H. R. Kruyt and J. Oosterman. *K. Akad. Amsterdam, Proc.* 40. 5. *pp.* 404–406, 1937.—The following results have been established: (1) The apparent flow potential is situated at the ends of the Pt capillary. (2) If the capillary wall is made into an unpolarisable electrode no e.m.f. can be observed in the flow. (3) The potential is not constant because, owing to the continuous discharge of ions, the amount of gas bound by the electrode and in consequence the p.d.s. of the H_2- and O_2-electrodes change continuously. (4) The electrode-potential is completely determined by the p.d.s. of the H_2- and O_2-electrode with the liquid. (5) It is fundamentally impossible to determine the electrokinetic potential of Pt accurately by means of flow-potential measurements. (6) The law of v. Smoluchowski has been tested and found to be applicable to an area of "wall conduction" of 400–100,000 Ω. H. H. Ho.

See also Abstracts 2885, 3105.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3244. Positron Spectrum of RaC. A. I. Alichanow and P. E. Spiwak. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 351–353, 1937. *In English.*—Continuing previous work [see Abstract 3337 (1936)] and using magnetic focusing with a radius of curvature of 14 cm. in conjunction with very small coincidence counters, positrons are found which are attributed to internal conversion of the weak α-ray lines at 1380 and 2470 ekV, emitted by RaC. Taking the results as a whole, good agreement is found with the theory of Jaeger and Hulme. [See following Abstract.] F. C. C.

3245. Positron Spectra Initiated by γ-Rays of RaC. A. I. Alichanow and P. E. Spiwak. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 354–355, 1937. *In English.*—Using an improved apparatus [see preceding Abstract] the positrons produced in Pb, Sn and Cu by the γ-rays from RaC are examined. The number-energy curve is similar for all three elements rising from zero to a maximum and falling again to zero, but as is to be expected from the interaction of the nuclear field, a greater proportion of high energy positrons is produced by the heavier nuclei. F. C. C.

3246. Magnetic Moment of the Proton. B. G. Lasarew and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion,* 11. 4. *pp.* 445–457, 1937. *In German.*—The magnetic susceptibility of solid H_2 has been measured at temperatures of 4·22°, 2·18° and 1·76° Abs., when it was established that within this range the diamagnetic susceptibility of the H_2 decreased, a phenomenon ascribed to an increase of paramagnetism produced by the magnetic moment of the proton. The magnetic moment of the proton, μ_p, was calculated from the temperature variation of the susceptibility as: $\mu_p = 2 \cdot 3 \pm 10\,\%$ nuclear magnetons and $\mu_s = 2 \cdot 7$ with an error of less than 10 %. The possibility of measuring the nuclear magnetism by means of the susceptibility has demonstrated that the establishment of equilibrium between field and H-nucleus takes place very rapidly. Full experimental details are included. H. H. Ho.

3247. Form of a Spot in Electron Diffraction Pattern. V. A. Kolpinsky. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 356–358, 1937. *In English.*—Short mathematical generalisation of the idea of the degeneration of a reciprocal lattice point. F. C. C.

3248. Scattering of Fast Electrons by Thin Material Foils. H. Saegusa and K. Kikuchi. *Tohoku Univ., Sci. Reports,* 25. *pp.* 817–828, *March,* 1937. *In English.*—Using the same Geiger electron counter as that described in our previous paper [see Abstract 4002 (1935)] and apparatus improved to some extent, the total angular distribution was investigated of the electrons scattered by some metallic foils such as Au, Pt, Ag and Ni, impinging fast electrons of such velocities as 10, 20 and 30 kV. The velocity distribution of the electrons scattered by such materials as Au and Al at an angle of 45° was also studied. The experimental result of the above angular distribution did not coincide with that of the theoretical result given by considering Coulomb's field. The ratio of the number of the scattered electrons to that calculated from the theory of Rutherford at various angles of scattering is calculated, assuming that the above ratio at the angle of 45° is equal to 1, and it is found that the ratios increase linearly with the angle of scattering from 45° to 80° and then except in some cases they tend to a stationary value. Thus it seems probable that there exists some scattering due to a non-coulombian field, as in the case of the anomalous scattering of the α-ray. AUTHORS.

3249. Paths of Charged Particles in Alternating Field of a Condenser and Effect of Stray Fields. H. Hintenberger. *Zeits. f. Physik,* 105. 7–8. *pp.* 501–512, 1937.—The paths of charged particles in the alternating field of a condenser are calculated and it is shown that for a wide range of velocities the effective field of the condenser can, for calculating the paths of the particles, be replaced by an ideal homogeneous alternating field. The extent and position of this ideal field is given for the two cases (*a*) where very thin condenser plates are employed, as in the Braun tube, and (*b*) where very thick condenser plates are used, the stray field being screened by means of earthed discs. Condensers were used of the type employed in velocity filters for kathode and canal rays. A. W.

3250. Polarisation of Electrons by Scattering in Crystals. E. David. *Zeits. f. Physik,* 105. 11–12. *pp.* 747–749, 1937.—Weisskopf [see Abstract 2257 (1935)] had shown that a polarisation effect of second order is obtained for those positions of the scattering crystal for which Bragg's condition is satisfied for two directions of reflection. It is now shown that this effect depends upon the angle of reflection in such a way that it is unmeasurably small in all practical cases. R. P.

3251. Secondary Electron Emission of Metals with a Low Work Function. H. Bruining and J. H. de Boer. *Physica,* 4. *pp.* 473–477, *June,* 1937. *In English.*—Conditions influencing the emission of secondary electrons are investigated. Work on pure metals shows that the maximum of secondary emission for metals of low work function is less than that for metals of high work function. For low primary electron velocities, therefore, the secondary emission is not determined primarily by the work function. Impurities, in the case of electropositive metals, increase appreciably the secondary emission. Secondary emission also varies with the thickness of the emitting layer, increasing with the thickness from that of the base metal to about twice the normal value, and then falling to the normal value for the deposited metal. C. J. B. C.

3252. Dimensional Relations for Electrons in Alternating Fields. Part II. E. Brüche and A. Recknagel. *Zeits. f. techn. Physik*, 18. 5. *pp.* 139–140, 1937.—In a previous paper [see Abstract 4362 (1936)] certain dimensional relations are given for electrons in a purely electrical alternating field. The case of an alternating magnetic field is now discussed. The results may be summarised: (1) Electrical alternating field $\omega(l/\sqrt{eU/m}) = K_1$; (2) static magnetic field $(eH/m)(l/\sqrt{eU/m}) = K_2$; (3) alternating magnetic field $(eH/m)(1/\nu) = K_3$, where l = dimension of system, *i.e.*, distance between corresponding points, and ν = frequency of alternation of the field. Given a system of alternating electric and magnetic fields through which electrons are travelling, the problem of doubling the frequency ω of the electric field, without altering the ray path is solved by the use of these dimensional relations. H. J. H. S.

***3253. Time Sweep of a Kathode-Ray Oscillograph. Calibration. F. C. Williams and J. P. Wolfenden.** *Wireless Engineer*, 14. *pp.* 315–317, *June*, 1937.—The usual superposition of a calibrating oscillation on an oscillogram obscures the wave under study or restricts it to a portion of the screen. By transferring the calibrating p.d. to the shield (modulator electrode) and adding a suitable steady bias, the peaks imprint dots on the screen, lying along the zero line. The calibrating wave is locked to the test frequency—in this case, mains supply. A rectifier run from the supply provides a non-sinusoidal wave-form at octave frequency; an amplifier valve with tuned anode circuit selects the third harmonic of this. The process is repeated in cascade. Thus 50 ∼ yields 300 ∼ and then 1800 ∼, and there are 36 dots per cycle, spaced apart by 10° (electrical). A distorted wave-form at the 300 ∼ is used to displace every sixth dot (at 60°). External plug connections provide for rapid readjustment of the frequency in the event of a change in power supply. R. M.

See also Abstracts 2878, 2892, 2902, 2962, 3058, 3096, 3265.

ELECTROSTATICS.

3254. Distribution of Charge on a Cylinder between Two Conducting Planes. E. Hallén. *Ann. d. Physik*, 29. 2. *pp.* 117–128, *May*, 1937.—Mainly mathematical. The charge distribution on a cylinder at zero potential between two planes at potentials ±V is calculated. From the results can be deduced certain capacitance values of importance in the theory of h.f. oscillations in solenoidal coils. [See also Abstract 4398 (1936).] N. F. A.

***3255. H.V. Generator Operating by Gaseous Flow. M. Pauthenier and Marguerite Moreau-Hanot.** *J. de Physique et le Radium*, 8. *pp.* 193–196, *May*, 1937.—A h.v. generator is described which is similar in external appearance to the van der Graaf generator but in which the charge is conveyed to a single aluminium sphere by a continuous current of air which is ionised by passage over an ioniser. The latter consists of a special arrangement of steel wires which are submitted to a corona discharge at 12 ekV. The potential which may be obtained is limited only by the height of the supporting column and by the diameter of the sphere; actually a potential of 1200 ekV was obtained with a sphere 75 cm. in dia. With the current of air flowing at the rate of 50 m./sec. and glass supply tubes of dia. 10 cm., sparks passed with a frequency of 1·2/sec, when the p.d. was 10^6 V. F. C. C.

See also Abstracts 3215, 3236.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3256. Thermomagnetic Nernst Effect in Cuprous Oxide. M. M. Noskow. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 307–319, 1937. *In German.*—An account is given of the measurement of the thermomagnetic Nernst effect in Cu_2O. The effect has a negative sign, and the order of magnitude is the same as that of the Nernst effect in metals. The results are explained by means of an application of Sommerfeld's theory of the behaviour of semiconductors. J. J. S.

See also Abstracts 3162, 3223.

MAGNETISM AND ELECTROMAGNETISM.

3257. Energy of a Very Small Magnetic Particle in a Magnetising Field. A Guilbert. *Comptes Rendus,* 204. *pp.* 1463–1465, *May* 19, 1937.—An expression for the increment of energy ΔW, appropriate, to a very small magnetic particle in a magnetic field of strength H is derived in the form $\Delta W = (H \cos \alpha \, dB_r - HB \sin \alpha \, d\alpha)\Delta V_T / 4\pi$, α denoting the angle between B and H, dB_r the radial variation of B, and ΔT_T the total volume of the particle, a conception introduced in the analysis. J. S. G. T.

3258. Properties of the Surface Magnetisation in Ferromagnetic Crystals. W. C. Elmore. *Phys. Rev.* 51. *pp.* 982–988, *June* 1, 1937.—The magnetic powder patterns found on polished iron crystals (which may contain a few % of Si) have been studied more carefully by using a macroscopic model and by investigating the forces on the powder particles. Reasons are given for preferring one of two simple models to explain the patterns; some interesting implications of the proposed model are then considered. Experiments are described which indicate that the structures under discussion originate during the polishing operation, but that other than magnetic causes must be responsible for the remarkable regularity of the patterns. AUTHOR.

3259. Ferromagnetic Properties of Paramagnetic Salts. L. W. Schubnikow and S. S. Schalyt. *Phys. Zeits. d. Sowjetunion,* 11. 5. *pp.* 566–570, 1937. *In German.*—Previous work [see Abstract 2778 (1936)] on the anhydrous paramagnetic salts $FeCl_2$, $CoCl_2$, $NiCl_2$ and $CrCl_3$ which exhibit specific heat anomalies, is now continued and the temperature dependence of the susceptibility of this salt found for the interval 14–80° K. The results indicated that the paramagnetic Curie-points found by extrapolation for $CoCl_2$ and $CrCl_3$ had no special physical significance. Irregularities, however, were found in the case of $NiCl_2$ at the temperatures of the specific heat anomalies. The latter phenomena are ascribed to the appearance of a moleculer field as in ordinary ferromagnetism. Curves are also drawn for the dependence $K = f(T)$, for hysteresis changes $B = f(H)$, and for remanent moments, at helium temperatures. Full experimental details are included. H. H. Ho.

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3260. Change of Magnetic Susceptibility in Metals During Melting and Allotropic Transformation. Y. Shimizu. *Tohoku Univ., Sci. Reports,* 25. *pp.* 921–938, *March,* 1937. *In English. Report No.* 415 *of the Research Inst. for Iron, Steel and other Metals.*—An accurate measurement of the abrupt change of magnetic susceptibility in metals during melting and allotropic transformation was made. An attempt is also made to explain quantitatively this abrupt change of susceptibility by applying the theory, which was proposed in the explanation of the change of susceptibility in metals caused by cold working. As is well known, tin changes the sign of its magnetic susceptibility twice as the temperature rises, that is, at the transformation point and also at the melting point. These interesting phenomena have been satisfactorily explained by the above theory. A good agreement has also been found between the observed change of susceptibility during melting and its theoretical value in the case of Cu, Ag, Au, Al, Hg, Na, K, Rb and Cs. AUTHOR.

3261. Variation of Diamagnetic Susceptibility of Water Due to Temperature. K. Honda and Y. Shimizu. *Tohoku Univ., Sci. Reports,* 25. *pp.* 939–945, *March,* 1937. *In English. Report No.* 416 *of the Research Inst. for Iron, Steel and other Metals.*—The magnetic susceptibility of water and its change due to temperature are theoretically calculated; the observed and calculated values coincide satisfactorily with each other. AUTHORS.

3262. Diamagnetism of Solutions of Iodine. C. Courty. *Comptes Rendus,* 204. *pp.* 1248–1250, *April* 26, 1937.—The diamagnetic susceptibilities of solutions of I_2 in $CHCl_3$, CCl_4, CS_2, C_6H_6, C_7H_8, and $(C_2H_5)_2O$ are given; and for some of the solvents also, *e.g.*, ether, $\chi \times 10^6 = -0 \cdot 766$, for CS_2, $-0 \cdot 540$ and for toluene, $-0 \cdot 718$. The ascertained results are compared with values calculated on the additivity theory. W. R. A.

3263. Paramagnetic Susceptibility of Lithium. S. R. Rao and S. Sriraman. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 343–350, *April,* 1937.—The paramagnetic susceptibility of Li is determined by the Curie method taking small quantities of the metal in pyrex glass bulbs. The glass walls and the metal were well degassed before the metal was sealed in the bulbs. The susceptibilities are determined at different field strengths and in each case the susceptibility at infinite field strength is deduced by extrapolation. The mean paramagnetic susceptibility is found to be $2 \cdot 6 \pm 10^{-6}$. This value is examined in the light of theoretical calculations of the paramagnetism of free electrons and it is shown to be in harmony with the general scheme of the alkali elements. AUTHORS.

3264. Magnetic Analysis of Evaporated Bi Deposits. C. T. Lane. *Phys. Rev.* 51. *pp.* 863–869, *May* 15, 1937.—The diamagnetic susceptibility of evaporated Bi films is independent of the thickness for films thicker than 0·5 μ. Below this the susceptibility decreases as the thickness is reduced. When thin films were aged for long periods in a vacuum, their susceptibility increased, but no such effect was noted with the thicker films. The susceptibility of the thicker films was the same whether they were deposited on glass, Au, Cu or Sn. The nature of the crystalline aggregate depends on the amount of residual gas present when the films are deposited. C. E. A.

3265. Generalisation of Aerodynamic and Electrodynamic Fundamental Equations. N. P. Kasterin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* [16 *pp.*] *Report delivered at Special Meeting, Dec.,* 1936. *In English.*—Maxwell's equations of the electromagnetic field and Euler's aerodynamic equations are regarded as only "first approximations." The author endeavours to obtain "second approximations" to these equations without the necessity of making any radical change in the principles of classical mechanics and physics. A parallelism is established between the equation of the vortex field and those of the electromagnetic field. The generalised electromagnetic field equations differ from Maxwell's equations in being non-linear, and the velocity of light in the field is variable. Structures of the proton, electron, neutron and neutrino are briefly discussed. J. S. G. T.

3266. Magnetic Losses at Low Flux Densities in 35 Permalloy Sheet. W. B. Ellwood and V. E. Legg. *J. of Applied Physics*, 8. *pp.* 351–358, *May*, 1937. *Bell System Techn. J.* 16. *pp.* 212–227, *April*, 1937.—In addition to losses due to eddy currents and hysteresis, a further loss is observed at low flux densities which has been termed either "residual," "magnetic viscosity" or "square law hysteresis." Accurate measurements of hysteresis loops and of a.c. losses are made in an endeavour to account for the origin of this residual loss. It is found that that part of the a.c. effective resistance of a coil wound on a ferromagnetic core which is proportional to the coil current is identical with the loop area as measured by a ballistic galvanometer. The loop may thus be constructed in detail on the basis of a.c. bridge measurements; this result applies to compressed Fe powder and annealed laminated 35 permalloy. The observed eddy-current losses in 35 permalloy are 20% greater than those calculated from classical theory; an explanation is offered. Analysis of the residual loss reveals an increase with frequency up to 500∼ (and a corresponding decrease in permeability), but a stationary value at higher frequencies (up to 10,000∼). [See also Abstract 1878 (1936).] H. J. H. S.

3267. Use of Liquid Nitrogen in Magnetic Experiments. P. Kapitza and C. J. Milner. *Journ. Sci. Instruments*, 14. *pp.* 201–203, *June*, 1937.—The paramagnetism of O_2 (commonly present as an impurity in liquid N_2) may lead to rises of temperature, due to various causes, when the liquid is placed in a magnetic field. The dependence of these upon the degree of purity of the liquid N_2 and the magnetic field strength is considered. A simple and sensitive method of measuring the O_2 content of a sample of liquid N_2 is described. AUTHORS.

***3268. Electromagnet with Small Power-Loss. W. Steubing.** *Zeits. f. techn. Physik*, 18. 6. *pp.* 160–164, 1937.—Describes an electromagnet designed to give a uniform strong field in the gap with minimum stray field. Its distinctive features are the use of a ring core with specially shaped pole-pieces and the placing of the windings as close as possible to the core. The coils are wound on a number of brass bobbins with double-walled cheeks used for water-cooling, and brass-strips are inserted between layers and soldered to the cheeks to give good heat-conduction. With ordinary truncated conical pole-pieces, field-strengths up to 49,000 oersteds are obtained for a consumption of about 5 kW, which is superior to the performance of comparable electromagnets of other types. C. E. W.

***3269. Small Electromagnet for Strong Fields. H. Lange.** *Phys. Zeits.* 38. *pp.* 384–386, *May* 15, 1937.—Describes an electromagnet of Ruhmkorff pattern weighing only 25 kg. and excited from a 12-V battery.

Field-strengths up to 40,000 oersteds are obtained in a 1 mm. gap and it is shown to be superior in performance to a Du Bois electromagnet of twice the weight and four times the power consumption. C. E. W.

See also Abstracts 3033, 3042, 3120, 3121.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***3270. Condenser-Discharge Stimulator for Physiological Purposes. O. A. M. Wyss.** *Science*, 85. *pp.* 431–432, *April* 30, 1937.—For use in physiological research, such as stimulation of brain and nerve tissue by electrical means, an apparatus is described consisting of two condensor-resistance circuits, which may be used singularly or jointly *via* balanced amplifier valves, current for the purpose in question being applied *via* balanced potentiometer circuits, the current so obtained being proportional to the plate current of the valves and having a wave-form similar to the wave-form across the resistances. B. J. L.

3271. Registering Method for Electrocardiographs. H. E. Hollmann and W. Hollmann. *Zeits. f. Instrumentenk.* 57. *pp.* 147–167, *April*, 1937.—The paper deals with the vectorial representation of the potential results on the electric axis of the heart. A method of arriving at the result using a 3-phase current to give Lissajous' figures is described in detail with examples. Finally a method of obtaining "stereoscopic cardiograms" is described. G. E. B.

3272. Biological Effect of Centimetre Waves. S. J. Turlyguin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 7. *pp.* 433–436, 1937. *In English.*—An h.f. generator was assembled consisting of 10 rectilinear vibrators (each 1 cm. long) in series, excited by the spark of a resonance transformer of 100 kV. The oscillating frequency reached approximately $1 \cdot 5 \times 10^{10}$ cycles ($\lambda \approx 2$ cm.). Experiments were made for the purpose of studying the effect of these oscillations on the germination of aster seeds. It has been found that, in spite of the low power of the generator—only a fraction of a milliwatt—the oscillations affect the seeds, accelerating the growth of the plants by about 20–45 % as compared with the control. A certain regularity in the influence of the exposure has been observed. It is considered that the effects of the heat from the spark and of the strong field of diathermic frequency have been eliminated in the experiments and that a specific biological effect of centimetre waves has been established. T. A. C.

3273. Measurement of the Erythema Picture of Ultra-Violet Light. E. Hasché. *E.T.Z.* 58. *pp.* 425–426, *April* 22, 1937.—For a measuring system to be of use in the u.v. region it is necessary for the response curve to simulate that of biological tissue. The response curve of a quartz-cadmium photo-cell with a uviol window has the necessary characteristics and is suggested that such a combination would be of use in u.v. therapy. G. E. B.

***3274. Ultra-Violet Dosimeter. L. W. Pollak and F. Fuchs.** *Gerlands Beitr. z. Geophys.* 50. 1. *pp.* 104–118, 1937. *English Abstract.*—An apparatus is described which, when combined with the photoelectric measuring device of the u.v. dosimeter, provides constancy of the illumination of the test tubes. An iris diaphragm is used to equalise the illumination of the light rays passing through the test tube. The results of the u.v. colorimeter compared with the individual results of the bioclimatic u.v. dosimeter with green-filter eyepiece show the reliability of the objective

measurements obtained with the photoelectric arrangement when a reliable photometer lamp and sensitive galvanometer are used. The photoelectric measurements of the colour change of the liquid in the test tubes show the usefulness of the bioclimatic u.v. dosimeter for meteorological work.
R. S. R.

3275. Effect of Various Filters in the 500 kV Range. K. E. Corrigan. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 520–528, *April*, 1937.—The general theory of absorption of X-rays in respect to various metals and voltages is briefly discussed, together with discontinuities of the absorption curves when the incident radiation undergoes characteristic absorption. In measurement of the half-layer value Lauritsen considers water is the best absorption medium, although other materials such as paraffin, wood, etc., may offer practical advantages. The intensity or depth dose of X-rays varies in accordance with the exciting voltage, but the change with filtration is relatively small. When in practice the half-layer value is measured, owing to scattered radiation, the results vary greatly from purely physical measurements where scattering does not result to such a great extent. Various curves of spectral distribution with and without filtration are then illustrated. In the use of lead filters, these should be backed by tin or some similar material to absorb characteristic radiation. Any filter material only causes hardening of the transmitted radiation up to a certain critical thickness, further filtration decreasing the efficiency of the particular X-ray tube. It is considered that relatively little increase of depth dosage by filtration is to be expected beyond a constant potential of 500 kV, unless an exceedingly large increase of voltage modifies the absorption phenomena. B. J. L.

3276. Ionisation Theory and Radio-Biological Reactions. C. E. Nurnberger. *Nat. Acad. Sci., Proc.* 23. *pp.* 189–193, *April*, 1937.—A number of investigators have recently observed considerable differences in the biological effect per unit of ionisation between neutrons and X-rays. The ionisation processes of neutrons and X-rays are discussed, the chief difference being the much larger ionic density along the proton tracks produced by neutrons than that along the electronic tracks produced by X-rays. Experiments are described in which tyrosine is irradiated with α-particles and the resulting solution analysed to determine the percentage decomposition of the tyrosine. It is shown that $M_T/N = 1/350$, where M_T is the number of tyrosine molecules decomposed and N the number of ion pairs produced in the solution. Previous work by Stenstrom and Lohmann in which tyrosine was irradiated with 200 kV X-rays resulted in values of M_T/N varying from 1/6 to 1/12. The experiments suggest that the chemical changes produced in tyrosine by ionisation depend on the ionic density. The effects of ionic recombination and of molecular activation are discussed, and it is shown that both effects would lead to low values of M_T/N for α-particles, as is found experimentally. It is pointed out that the results are in direct opposition to the selective effects observed in the biological action of X-rays and neutrons. J. E. R.

3277. Comparison of X-Ray Intensities by Time Measurements. H. L. Brose and E. H. Molesworth. *Brit. J. of Radiology*, 10. *pp.* 427–429, *May*, 1937.—In a previous paper [see Abstract 1843 (1937)] the authors described a method of comparing the intensities of two X-ray beams by photographic means. The present paper describes a simpler technique, involving exposing a film to the two beams for three or four different times and finding the times required to give equal blackenings. This procedure is possible since the validity of the Bunsen-Roscoe law has been established in the case of X-rays. G. E. B.

3278. Increased Acoustic Sensitivity in Dogs after X-Radiation of the Hypophysis. W. T. Brogden and E. Culler. *Am. J. Physiol.* 119. *pp.* 13–23, *May* 1, 1937.—Transient gain in acoustic sensitivity following X-radiation of the head was confirmed for frequencies 125, 1000 and 8000. Magnitude and duration of effect remain constant for the range 75 to 675 r-units. Its latency decreases as the dosage increases. The effect is slightly less at frequency 125 than at the other frequencies. Other pathological changes are described. G. E. A.

3279. Problem in γ-Ray Therapy. W. H. Love. *Brit. J. of Radiology,* 10. *pp.* 430–431, *May,* 1937.—A mathematical paper concerned with the problem of the dosage administered by a ring-shaped source of radioactive material pressed into contact with a curved surface. The final result is contained in a relatively simple formula. G. E. B.

OSCILLATIONS AND WAVES.

***3280. H.F. Filament Supply for Ion Sources. J. R. Dunning and H. L. Anderson.** *Rev. Sci. Instruments,* 8. *pp.* 158–159, *May,* 1937.—Currents of the order of 100 A at 6 V and 50–200 kc. are easily obtained from an oscillator employing a 1000 W air-cooled valve in the Hartley circuit. Full details of such an oscillator designed to supply power for the filament of the ion source in the Columbia University cyclotron are given, and it is claimed that filament failures due to vibration and magnetic strains are obviated. Methods of measuring and transmitting the h.f. current are discussed. A. G. Q.

***3281. Short-Wave Oscillator. T. V. Ionescu.** *Comptes Rendus,* 204. *pp.* 1411–1413, *May* 10, 1937.—The paper describes a novel form of valve consisting of two circular aluminium plates about 2·5 cm. dia. placed 8 cm. apart, with a ring electrode of copper halfway between them. Each of the plates has a 0·5 cm. hole in the middle and behind one of these holes is a tungsten kathode. The whole system is mounted in a tube connected to a pump so that the pressure can be varied. A pair of coils is arranged so that axial magnetic fields up to about 90 gauss can be applied. A Lecher-wire system is connected between the ring electrode and the two plates which are connected together externally. No theory of the operation of this valve is given but the results obtained under various conditions are stated, and one definite set of results gives a wave-length of 36 cm. F. S. B.

***3282. Impulse Generator with Variable Frequency. A. J. Usikow.** *Phys. Zeits. d. Sowjetunion,* 11. 4. *pp.* 414–424, 1937. *In English.*—An instrument is described with which narrow current impulses may be obtained. With the constructions described impulses of about 1 A may be secured at voltages up to 10 kV. The duration of an impulse may be varied from 10^{-3} to 10^{-5} sec., the frequency from 0 to 5 kc./sec. The instrument may be used as a modulator to obtain very powerful current impulses of the duration mentioned without additional cascade amplification. [See also Abstract 2423 (1936).] AUTHOR.

***3283. Portable Valve Amplifier for Photoelectric Currents. G. H. Gabus and M. L. Pool.** *Rev. Sci. Instruments,* 8. *pp.* 196–198, *June,* 1937.—The problem of the amplification of minute photoelectric currents by means of standard radio apparatus is discussed and a common reason for failure to obtain high sensitivity with ordinary valves is pointed out. A radio receiving valve is described and its input resistance is raised from 10^8 to 10^{12} ohms by means of special use of its grids together with greatly reduced operating voltages. It is shown that this value of input resistance is higher than necessary for ordinary measurements made with the various electrometer type valves. A comparison curve, showing the region of applicability for three valve types, is included.

3284. Application of the Theory of Probability to the Effect of Fading. A. Shukin. *Techn. Phys., U.S.S.R.* 4. 2. *pp.* 91–109, 1937. *In English.*—An examination is made of fading due to the interference of some definite number of circularly polarised waves with different but constant amplitudes and with arbitrary phase displacements relative to one another. Expressions are obtained for the probability that during a certain proportion of the time of observation the signal e.m.f. falls below a certain level, and certain conclusions are drawn with reference to this type of fading. It is pointed out, however, that variable absorption may be an important factor in producing fading and that if variations of absorption do occur, the formulæ developed in the present paper for fading due to interference might need considerable correction. A. W.

3285. Sudden Ionospheric Disturbances. J. H. Dellinger. *Terr. Mag.* 42. *pp.* 49–53, *March*, 1937.—This refers to sudden fade-outs on short-wave channels accompanied by augmented reception of atmospherics on long waves [see Abstract 933 (1936).]. 115 reported occurrences of it during 1934–1936 are tabulated and correlation is given with (1) solar eruptions, (2) magnetic pulses and (3) earth-current pulses. With (3) and (2) the simultaneity of commencement is within a few minutes; as it is sometimes with (1), but apparently the eruptions themselves cannot be timed accurately. The magnetic pulses (2) are of a separate type not formerly so recognised. The disturbance is due to sudden abnormal ionisation of a region below the E-layer. It occurs in daylight only, and is strongest at noon and near the tropics—contrary to magnetic storms—indicating solar eruptions as the source of the radiation producing the ionisation. It is probably short-wave u.v. radiation, different from that producing ionisation of the E- and higher layers; and it can be studied only *via* these disturbances. It constitutes also a tool for further study of the mechanisms of terrestrial-magnetic variations. R. M.

3286. Vertical Movements of the Air in the Upper Atmosphere. L. Harang. *Terr. Mag.* 42. *pp.* 55–72, *March*, 1937.—In a previous paper [see Abstract 4904 (1936)] a number of observations of auroræ and ionospheric constants were considered. This paper is an extension of the previous results with a further discussion. The aspects of the problem considered are diurnal temperature variations at a height of 100 km., diurnal effects in the F_1- and F_2-layers, effects of magnetic storms on the layers, annual variation of the noon value of critical frequency, absence of the E-layer in midwinter. Most of the work described has been done at the Auroral Observatory in Tromsö. F. S. B.

3287. Radio Study of the Physics of the Globe. R. Jouaust. *Onde Élec.* 16. *pp.* 211–216, *April*, 1937.—It is stated that, in general, solar eruptions precede the fade-outs by about 10 min. The simultaneous increased intensity of atmospherics on long waves is interpreted as due to the better propagation caused by reflection from the low highly-conducting ionised layer. The nature of the radiation is not accounted for by the sun being a black body at 6000° K., and may be due, for example, to He resonance. The high conductivity of the new layer, leading to increase in the currents in the upper atmosphere, is probably the cause of the related magnetic anomalies. Indications were found of a period of 27 days, the sun's synodic period. R. M.

3288. Characteristics of the Ionosphere and their Application to Radio Transmission. T. R. Gilliland, S. S. Kirby, N. Smith and S. E. Reymer. *Bureau of Standards, J. of Research,* 18. *pp.* 645–667, *June,* 1937.—Results of ionosphere measurements near Washington, D.C., made at normal incidence over the period May 1934 to Dec., 1936, inclusive, are presented in graphical form as monthly averages for each hour of the day. The general forms of the diurnal and seasonal variations of the critical frequencies and virtual heights have recurred from year to year. In addition to the seasonal variation there has been a continuous long-time increase of critical frequencies which is associated with the 11-year sunspot cycle. Data are given only for those layers which are fairly regular in behaviour—the normal E, F, F_1, and F_2 layers. The interpretation of properties of the ionosphere in terms of radio transmission over medium and long distances is discussed. The properties considered are absorption, virtual height, and critical frequency. It is pointed out that the long-time increase of critical frequencies indicates a corresponding rise in useful transmission frequencies. The paper also describes briefly two types of irregular disturbances of the ionosphere which affect radio transmission. AUTHORS.

See also Abstracts 3254, 3300.

PHOTOELECTRICITY.

3289. Photoelectric Properties of Atomic Layers of Potassium. H. Mayer. *Ann. d. Physik,* 29. 2. *pp.* 129–159, *May,* 1937.—A description is given of an atomic beam method whereby extremely thin layers of alkali metals can be deposited on Pt and their thicknesses accurately measured. The photoelectric behaviour of such layers of K is investigated for thicknesses up to about 30 atoms and for the stronger Hg arc lines from 2400 to 6000 Å. The most favourable covering of the surface (minimum work function) corresponds to about 0·7 of a monatomic layer, but when gas atoms are also present the figure is higher. Up to between 2 and 3 atoms thick the effect is normal; at bigger thicknesses the selective effect appears. The wave-length limit for gas-free K is found to be 5461, corresponding to a work function of 2·26 ± 0·02 V. The lowest figure observed when gas atoms are present is 2·0 V. Qualitative conclusions as to the velocity distribution of the photoelectrons from layers of different thicknesses are drawn from observed current-voltage curves. L. A. W.

3290. Optical Constants of Sodium. H. E. Ives and H. B. Briggs. *J.O.S.A.* 27. *pp.* 181–185, *May,* 1937.—Results of measurements of the optical constants of K in the range λ2536 to λ5780 have already been reported [see Abstract 4410 (1936)]. The results for a similar investigation in the case of Na are now given, the method being the same as that previously described, but considerable difficulty was experienced in obtaining a suitable Na surface. The agreement between the experimental values and those calculated from Kronig's theory is decidedly better than it was for K. A. H.

3291. Time Lag of Vacuum Photoelectric Cell. R. A. Houstoun. *Roy. Soc. Edinburgh, Proc.* 57. 2. *pp.* 163–171, 1937.—An image, 0·3mm. wide, of the filament of a lamp was repeatedly swept across the kathode of a vacuum photo-cell by a revolving mirror at a distance of 1 m. The photoelectric currents were compared when the mirror speeds were in turn 320 and 15 r.p.s. An account is given of three different methods of rapidly rotating a mirror. With a cell having a thin-film K kathode there was no significant difference at the two speeds, but with a kathode of K deposited in bulk and sensitised the current was on the average 0·6 % less at the higher speed. It is shown that this difference could be produced by a lag of 5×10^{-10} sec. in the emission of electrons on illumination. It is pointed out that a cell of this type, unlike the thin-film K type, should not be regarded as a true vacuum cell on account of the evolution of a small quantity of H from the sensitised K surface. D. H. F.

3292. Photoelectric Cell Characteristics. R. M. Holmes. *Electronics,* 10. *pp.* 33, 56, 58 and 60, *April,* 1937.—Measurements are made of the current and voltage outputs of "Electrocell" photo-cells consisting of the combination: translucent metallic film-Se-iron disc. Using a standardised light source at a colour temperature of 3230° K., the photo-current is found to vary nearly linearly with luminous flux up to about 0·06 lumen/cm.^{2}. For this illumination the current is 250 μA for a cell having a sensitive area of 9 cm.^{2}. At higher illuminations the current increases at a lower rate, but for a flux of 16 lumens the current is 2·8 mA. Voltage output varies in a similar manner. At the relatively low illumination of 0·0065 lumen/cm.^{2} the open circuit voltage is 0·25 V while at 20 times this illumination the voltage becomes 0·52 V. Measurements with an equal energy spectrum obtained from a mercury arc with Wratten filters and thermopile show the cell to have its maximum response at about 580 mμ but the current is 65 % of this maximum value for the near ultra-violet (365 mμ). AUTHOR.

***3293. Development of Photoelectric Cells. R. Sewig.** *Naturwiss.* 25. *pp.* 321–324, *May* 21, 1937.—A condensed survey of the improvements which have been made in the different types of photo-cells, followed by a short section on possible developments and applications. L. A. W.

3294. Temperature Effect on Primary Photoelectric Current in Crystals. R. W. Pohl. *Ann. d. Physik,* 29. 3–4. *pp.* 239–245, *June,* 1937.—The mobility of electrons which are produced in a NaCl crystal by absorption of light in the "F band" is measured for different temperatures. It increases with decreasing temperature down to liquid-air temperature, but at still lower temperatures shows a steep decrease. Similar results are found for KCl except that there, upon further lowering the temperature, another slow rise follows. R. P.

3295. Spectral Distribution of Inner Photoelectric Effect in Cu_2O. A. W. Joffé and A. T. Joffé. *Phys. Zeits. d. Sowjetunion,* 11. 3. *pp.* 241–262, 1937. *In English.*—Measurements of the spectral distribution of photo-conductivity in Cu_2O show that the maximum is displaced from its normal position at 6300 Å towards shorter wave-lengths with decreasing thickness of the specimen, and at 9 μ it is the same as that of the blocking-layer effect, which has a maximum at 5400 Å. A new maximum of the inner photoelectric effect was observed at 2800 Å. The photo-conductivity per unit of absorbed energy or per number of absorbed photons is independent of wave-length in the visible spectrum. An apparent decrease of the effect in the u.v. is evidently due to insufficient account being taken of the reflection of light from the surface, and a decrease in the far red region is due to the appearance of a second absorption band. It is concluded that the supposed relationship between the maximum of the inner photoelectric effect and the eigenfrequencies of the valency electrons is discredited. D. H. F.

See also Abstracts 3251, 3283.

PIEZOELECTRICITY.

3296. Piezoelectric Effect in Ammonium Chloride Crystals at the Transformation Point. S. Bahrs and J. Engl. *Zeits. f. Physik,* 105. 7–8. *pp.* 470–477, 1937.—The course of the piezoelectric effect in NH_4Cl crystals in the neighbourhood of the transformation point, 30·5° C., was measured. Within a temperature range of 2° the piezoelectric effect increases from zero to its full value. J. J. S.

3297. Piezoelectric Plates of Non-Uniform Thickness. A. Guerbilsky. *J. de Physique et le Radium,* 8. *pp.* 165–168, *April,* 1937.—By extending the standard representation of a piezoelectric plate in terms of an equivalent system of inductances, capacities and resistances the author seeks to explain by a simple theory the effects which are obtained when a wedge-shaped piece of quartz is made to vibrate in resonance, corresponding to its varying thickness. By means of this theory it is possible to eliminate many of the extraneous factors which make the resonance curve of such a slab of quartz very irregular. It is suggested that the results obtained might have technical applications to electro-optical relays for the photographic registration of sound, modulating apparatus for light beams in television and band filters for h.f. currents. G. G.

3298. Vibrations in Quartz Plates Cut in Different Planes around the Optic Axis. Ny Tsi-Zé and Shang Keng-Yi. *Comptes Rendus,* 204. *pp.* 1059–1060, *April* 5, 1937.—The usual piezoelectric quartz plate (as described by Curie) is perpendicular to the optic axis. The authors investigate similar plates but whose normals make with the optic axis not only 0° (as in Curie's case) but also angles of 5, 10, 15, 20, 25 and 30°. Curves are given which represent their results and which give the mean frequency of vibration reduced to thicknesses of one mm. Three modes of vibration previously observed by de Gramont are recorded, also a vibration along the optic axis and a vibration along the length of the plate. Certain of these vibrations do not exist in all the plates, but only in certain angular ranges of plate orientation with respect to the optic axis. G. G.

THERMIONICS.

3299. Emission of Positive Ions. Maria A. Sforzini-Pierotti. *N. Cimento,* 14. *pp.* 8–13, *Jan.,* 1937.—The emission of positive ions from a metal has been studied, with special reference to the temperature at which emission commences for a tungsten wire. Emission sets in at 170° C., while preliminary experiments on Pt indicate that positive ions are emitted from this metal at a temperature of 50° C. C. J. B. C.

3300. Thermionic Current in Valves. T. Franzini. *N. Cimento,* 14. *pp.* 53–63, *Feb.,* 1937.—If the filament is directly heated with a.c. the anode current shows oscillations with time. These oscillations are measured for a number of diodes and triodes and compared with the theoretical formula derived by the author. R. P.

See also Abstracts 3280, 3289.

THERMOELECTRICITY.

3301. Electrothermic Homogeneous Effect in Liquid Mercury. C. Benedicks and P. Sederholm. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 22 [20 *pp.*], 1937. *In English.*—Direct measurements of the ETH effect in Hg, using a thin calibrated capillary are given; apparatus used is described. Eventual Thomson effect and other possible sources of error are discussed. The measurements do not yet possess an absolute quantitative character. Very regular results were obtained, well confirming the existence of the ETH effect in Hg. It was found, however, that the magnitude, and even the sign, of the effect obtained were subjected to considerable variations. These proved to be due to a varying content of air, or moisture, a considerable change being caused by degassing. Thus, the ETH effect in Hg must be a duplex one: (1) Metal effect, being positive; (2) gas effect, being negative. A similar gas effect occurs in Pt, and to some extent, in Cu. In a special apparatus determinations were made on strictly air-free Hg. These confirmed the above results of the metal-effect being positive. The influence of p.d. and temperature was investigated. It follows from the new results, that the sign of the Thomson effect in Hg, given as negative, will probably be found to be positive in strictly pure Hg. The behaviour of Hg as regards the ETH effect is elucidated. [See also Abstract 405 (1937).] AUTHORS.

3302. Transversal Thermo-E.M.F. in Single Crystals. H. Reddemann. *Ann. d. Physik,* 29. 3–4. *pp.* 286–296, *June,* 1937.—According to the theory of thermo-e.m.f. in anisotropic crystals, as it was developed by Thomson and Voigt, there occurs at right angles to an electric current in the crystal a difference of temperature, and inversely, perpendicular to a flow of heat a difference of potential. The first effect—the so-called transverse Peltier effect—has been observed by several investigators, but for the most part only qualitatively. The existence of the second effect—the transversal thermo-e.m.f.—appears to have been hitherto established only by Terada and Tsutsui [*Imp. Acad. Tokyo, Proc.* 3. *p.* 132, 1927] but in their paper no quantitative results are given. In the present paper there is first of all set down what is to be expected according to Thomson's theory of thermo-e.m.f., and secondly the effect is measured in a plate of a single crystal of Bi at — 178° C. and — 190° C. A description is given of the details of the experimental arrangement. Wires of constantan, manganin and Cu were used in the determinations, and wires of Cu and manganin served simultaneously for the measurement of the differences of temperature and potential at various places in the crystal. A specimen of commercial Bi was used, and the results are stated in a table in which the differential thermo-e.m.f. of Bi against manganin and constantan is included. J. J. S.

See also Abstract 3223.